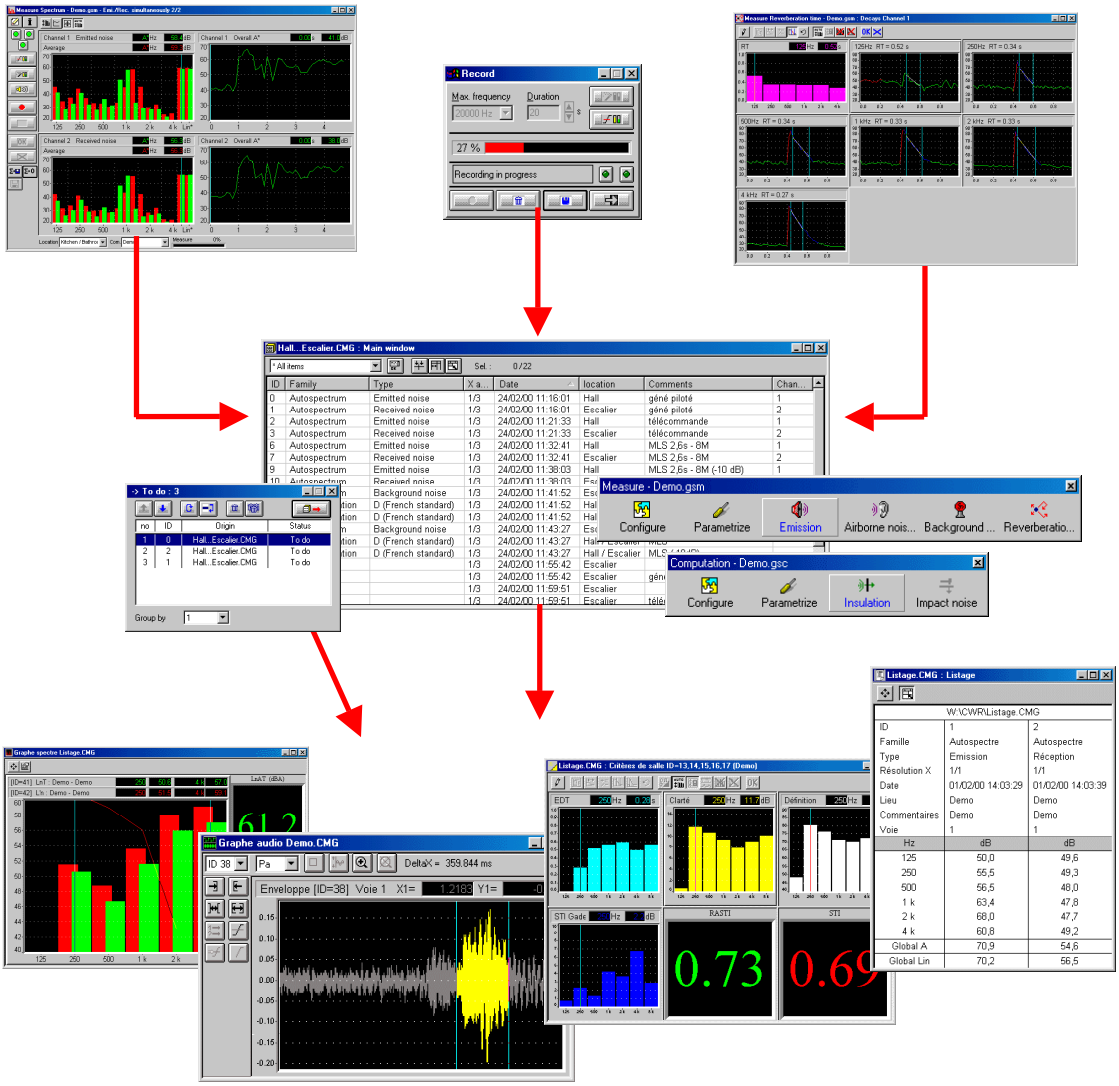
dBBATI32
Building acoustics



01dB acoustics & vibration
METRAVIB technologies

USER MANUAL

Copyright ©

dBBATI32

Building acoustics measurement and processing software
User manual

💻 infogb@01dB.com

🌍 www.01dB.com

01dB Head Office
200, chemin des Ormeaux
F-69578 Limonest Cedex
FRANCE
☎ +33 4 72 52 48 00
🖷 +33 4 72 52 47 47

01dB Italia s.r.l.
Via Antoniana, 278
35011 Campodarsego
ITALY

☎ +39 049 92 00 966
🖷 +39 049 92 01 239

01dB Inc.
31 Jordan Street
P.O. Box 796
Skaneateles NY 13152
USA

☎ +1 315 685 3141
🖷 +1 315 685 3194

01dB do Brasil
Rua Domingos de Morais 2102
Sala 11 – 1 Andar – Vila Mariana
04036-000 Saõ Paulo
BRAZIL

☎ +55 11 5579 6460
🖷 +55 11 5579 6610

01dB Asia Pacific
No. 9 Jalan USJ10/1D
47620 Petaling Jaya
Selangor
MALAYSIA

☎ +60 3 563 22 633
🖷 +60 3 563 18 633

The specifications are subject to change without notice.

SYMPHONIE® is a registered trademark of 01dB
MICROSOFT® is a registered trademark Microsoft Corporation
Windows 95™, Windows 98™ are trademarks of Microsoft Corporation

P83MAN30-04 NOT1109

gb_dBBATI32_4.1_manual_04.doc – Updated on: October 2003

TABLE OF CONTENTS [1]

1. DESCRIPTION OF A 01DB-STELL PC BASED MEASUREMENT CHAIN 9

1.1. INTRODUCTION 9
1.2. GENERAL DESCRIPTION 10
1.3. BUILDING ACOUSTICS APPLICATIONS 11

2. NEW FEATURES 13

3. ACQUISITION, ANALYSIS AND COMPUTATION WITH DBBATI32 15

3.1. OVERVIEW OF THE SOFTWARE PACKAGE : PRINCIPLE OF OPERATION 15
3.2. MEASURING WITH DBBATI32 16
3.2.1. Common steps 16
3.2.2. Types of measurements in dBBATI32 16
3.2.3. Spectra measurements 17
3.2.4. Equipment noise measurements 18
3.2.5. Reverberation time measurements 19
3.2.6. Room criteria measurements 20
3.2.7. Signal recording 21
3.2.8. Acquisition en mode MLS 21
3.3. DATA PROCESSING IN DBBATI32 22

4. HARDWARE CONFIGURATION 25

5. MEASUREMENT CHAIN CALIBRATION 27

6. USE OF THE MANAGERS 29

6.1. INTRODUCTION 29
6.2. CONFIGURATION OF A MANAGER 29
6.3. SET-UP OF A MANAGER 30

7. SPECTRA MEASUREMENTS 31

7.1. MEASUREMENT WINDOW OVERVIEW 32
7.2. MEASUREMENT SET-UP 33
7.2.1. Acquisition channel types for spectrum measurement 33
7.2.2. Analysis parameters 33
7.2.3. Signal characteristics 34
7.2.4. Measurement options 35
7.2.4.1. Acquisition options 35
7.2.4.2. Averaging options 35
7.2.5. Gain and threshold command, autorange 36
7.3. DISPLAY SET-UP AND STATUS BAR 38
7.3.1. Dynamic settings 38
7.3.2. Status bar 38
7.4. MEASUREMENT PROCESS 39

8. MECHANICAL EQUIPMENT NOISE MEASUREMENT 41

8.1. MEASUREMENT SET-UP 42
8.2. MEASUREMENT WINDOW OVERVIEW 43
8.3. DISPLAY SET-UP AND STATUS BAR 44
8.3.1. Dynamic settings 44
8.3.2. Display time history 44
8.3.3. Manual determination of the equipment noise level 44
8.3.4. Graphical settings 44
8.3.5. Status bar 45
8.4. MEASUREMENT PROCESS 45

[1] **Important Notice**: Because this software package is modular in structure, some of the functions described in this manual may not be available in your copy of the software. To upgrade your version with optional modules, contact your 01dB agent.

9. REVERBERATION TIME (RT) MEASUREMENTS 47

9.1. MEASUREMENT WINDOW OVERVIEW 48
9.2. MEASUREMENT SET-UP 49
9.2.1. Acquisition channel types for RT measurement 49
9.2.2. Analysis parameters 49
9.2.3. Signal characteristics 50
9.2.4. RT computation parameters 51
9.2.5. Measurement options 52
9.2.5.1. Acquisition options 52
9.2.5.2. Averaging options 52
9.2.6. Gain and threshold command, autorange 53
9.3. DISPLAY SET-UP AND STATUS BAR 55
9.3.1. Dynamic settings 55
9.3.2. Status bar 55
9.4. MEASUREMENT PROCESS 56
9.4.1. Procedure 56
9.4.2. Sketches 56

10. DECAY EDITION WINDOW (RT) 59

11. ROOM CRITERIA MEASUREMENTS 61

11.1. MEASUREMENT WINDOW OVERVIEW 62
11.2. MEASUREMENT SET-UP 63
11.2.1. Acquisition channel types for room criteria measurement 63
11.2.2. Analysis parameters 63
11.2.3. Signal characteristics 64
11.2.4. Criteria computation parameters 65
11.2.5. Measurement options 65
11.2.6. Gain and threshold command, autorange 66
11.3. DISPLAY SET-UP AND STATUS BAR 68
11.3.1. Dynamic settings 68
11.3.2. Status bar 68
11.4. MEASUREMENT PROCESS 69
11.4.1. Procedure 69
11.4.2. Sketches 70

12. DECAY EDITION WINDOW (ROOM CRITERIA) 71

13. SIGNAL ACQUISITION 73

13.1. RECORDING COMMAND 73
13.2. GAIN AND THRESHOLD COMMAND 75
13.3. RECORD CONFIGURATION COMMAND 76

14. MLS ACQUISITION MODE 77

14.1. SET-UP AND MEASUREMENT 77
14.2. GAIN SETTINGS 78

15. MANAGEMENT OF MEASUREMENT SESSION DATAFILES (CMG) 81

15.1. CMG DATAFILE MANAGEMENT 81
15.1.1. New CMG datafile 81
15.1.2. Open a CMG datafile 82
15.1.3. Close a CMG datafile 82
15.1.4. Save a CMG datafile 82
15.1.5. Delete one or several CMG datafile(s) 82
15.2. MEASUREMENT SESSION WINDOW OVERVIEW 83
15.2.1. Toolbars 83
15.2.2. Measurement session information window 84
15.2.3. Measurement session comments 84
15.2.4. Playback audio events 84
15.2.5. Delete data items 84
15.2.6. Modify data items (edition) 85
15.2.6.1. Edition of items : date and time 85
15.2.6.2. Edition of items : location and comments 85
15.2.6.3. Edition of items : Level conversion 85

15.2.6.4. Edition of items : study zone 86
15.2.6.5. Edition of items : Type for building acoustics 86
15.2.6.6. Edition of items : Information 86
15.2.7. Create new data item 87
15.2.8. Operations on data items 87
15.3. PLOT DATA ITEMS (GRAPHICS) 88
15.3.1. Signal view 88
15.3.2. Broad band spectra view 90
15.3.2.1. Display parameters of the graphical view 90
15.3.2.2. Data parameters for the graphical view 91
15.4. LISTINGS OF DATA ITEMS (TABLES) 92
15.5. AUTOMATIC TEST REPORTS 93
15.6. DESCRIPTION AND SELECTION OF COLUMNS IN A MEASUREMENT SESSION WINDOW 95
15.7. EDITION AND EXECUTION OF REQUESTS (DATA SORTING) 96
15.7.1. Overview of requests' edition 96
15.7.2. Add or modify a request (local or global 97
15.7.2.1. Overview 97
15.7.2.2. Definition principle 98
15.7.2.3. List of the values available to define a request 99
15.7.3. Execute a request 101
15.8. RESULT EXPLOITATION AND CUSTOMISATION 102
15.8.1. Printing results 102
15.8.2. Export data to a word or spreadsheet processor 103
15.8.3. Principle and configuration of the Copy command 104
15.8.4. Exportation of data at ASCII format (TXT file) 105
15.8.5. Customisation of dBBATI32 107
15.8.5.1. Select the colours of the data to display 107
15.8.5.2. Select the fonts of the data to display 107
15.8.5.3. General functions 107
15.8.5.4. Start options 109
15.8.5.5. Parameters for operations on data items 109
15.8.5.6. Measurement session general options 109

16. SPECTRA ANALYSIS 111

16.1. ANALYSIS WINDOW OVERVIEW 112
16.2. ANALYSIS SET-UP 113
16.2.1. Analysis parameters 113
Averaging and processing options 113
16.3. DISPLAY SET-UP AND STATUS BAR 114
16.3.1. Dynamic settings 114
16.3.2. Status bar 114
16.4. SELECTION OF AUDIO RECORDS TO ANALYSE 115
16.5. ANALYSIS PROCESS 115

17. REVERBERATION TIME (RT) ANALYSIS 117

17.1. ANALYSIS WINDOW OVERVIEW 118
17.2. ANALYSIS SET-UP 119
17.2.1. Analysis parameters 119
17.2.2. RT computation parameters 119
17.2.3. Processing and averaging parameters 119
17.3. DISPLAY SET-UP AND STATUS BAR 120
17.3.1. Dynamic settings 120
17.3.2. Status bar 120
17.4. SELECTION OF RECORDS TO ANALYSE 121
17.5. ANALYSIS PROCESS 122

18. ROOM CRITERIA ANALYSIS 123

18.1. ANALYSIS WINDOW OVERVIEW 124
18.2. ANALYSIS SET-UP 125
18.2.1. Analysis parameters 125
18.2.2. Criteria computation parameters 125
18.2.3. Analysis options 125
18.3. DISPLAY SET-UP AND STATUS BAR 126
18.3.1. Dynamic settings 126
18.3.2. Status bar 126

18.4. SELECTION OF RECORDS TO ANALYSE 127
18.5. ANALYSIS PROCESS 127

19. STANDARD CALCULATIONS 129

19.1. COMPUTATION PARAMETERS 129
19.2. COMPUTATION PROCESS 131
19.2.1. Selection of the data items 131
19.2.2. Run the computation 132

20. SIMPLIFIED USER LEVEL 133

20.1. LIMITATIONS 133
20.2. MEASUREMENT MANAGER SET-UP (SIMPLIFIED VERSION) 134

21. APPENDICES 137

21.1 EDITION OF THE SOFTWARE LICENCE NUMBER 137
21.2. MLS TECHNIQUE 137
21.3. REVERBERATION TIME CALCULATION ALGORITHM 138
21.4. STANDARD CALCULATIONS 143
21.4.1. Insulation 143
21.4.2. Impact noise 146
21.4.3. Mechanical equipment noise 147
21.4.4. Absorption coefficient 148
21.5. ROOM CRITERIA 151
21.5.1. Reverberation time 151
21.5.2. Energy criteria 152
21.5.3. Intelligibility criteria 154

1. DESCRIPTION OF A 01DB-STELL PC BASED MEASUREMENT CHAIN

You have purchased a 01dB PC-based system to perform sound and vibration analysis. The 01dB concept is to combine sound and vibration instrumentation with the computational and management facilities of a PC.

For first time users of a PC based measurement chain, the following chapter describes the concept with respect to environmental noise measurements.

📖 ***For more general information on the concept of a PC – based measurement system, see the "getting started user manual" delivered with your measurement system.***

1.1. Introduction

The use of personal computers for acoustical measurement and data processing has been a topic of much discussion, even controversy over recent years. The phenomenal growth in PC technology now offers the benefits of computational speed and flexibility that are being employed in many areas of research and engineering applications.

Traditionally the function of acoustical measurement has belonged to the dedicated instrument while the computer has carried out the tasks of data storage, display and basic processing. The interface between the two has been either an RS-232 serial communication or manual entry via a keyboard. Human error, excessive time and long rolls of silver paper are just some of the disadvantages of this system.

An attractive solution for the pure technologist is to build a PC based instrument, though the benefits over the dedicated instrument should be apparent. Alternatively, the design of an optimum PC based measurement system will depend on the management of data handling between the dedicated hardware and the PC environment. The possibility of flexible and creative solutions that offer a very high degree of accuracy over a wide range of applications have been sought and developed over the last ten years by the team at 01dB.

1.2. General description

01dB have developed a modular PC - based measurement chain, similar to that used by traditional stand-alone measurement systems. This generic approach applies to sound level meters, tape recorders or multi-channel analysers. The principle features are:

- **A transducer** that transforms a physical quantity into an electrical input signal.
- **A signal conditioner** amplifies and conditions the electrical signal for treatment in an acquisition unit. Conditioning units require power supply.
- **An acquisition platform** or digital signal-processing unit (DSP) with some dedicated DSP function performing the actual measurements.

To control the instrument, a visual display panel is necessary. In addition, the results (spectra, time histories, etc.) require a graphical interface. Dedicated calculation functions, such as the calculation of building acoustics criteria, may be performed on the input signals. The results, which may take the form of a raw audio recording or a set of Ln measurements for example, must be stored to allow post-processing operations.

The **personal computer** may be used as a host to a dedicated instrument. Duplication of function, however, quickly becomes apparent. A PC may handle many internal functions of the dedicated instrument more efficiently. Benefits of the PC include access to greater storage capacity, input / output devices, higher resolution with a Windows™ style graphical interface and general integration with the computer based design environment. The computer may also take responsibility for system control. (Note that some existing analysers actually feature an internal Intel x86 PC processor as the system controller)

The application software determines the type of measurement that the user is able to perform The PC platform controls the user interface, graphics, storage and post processing functions. Here lies the real advantage of a virtual instrument: with 01dB application software the user has the possibility to choose the nature of the measurement system. It may be a sound level meter, a real time analyser, a digital tape recorder, etc.

However, it should be remembered that for acoustics, computer technology is not an end in itself but a tool to provide the most efficient and accurate method of sound and vibration measurement.

What is a PC based measuring system? It is a system comprising hardware resources, software modules and a host computer, which must meet the current Standards for corresponding dedicated instruments. The field of acoustical measurement is yet, dominated by the use of dedicated instruments, with standards and tests to reflect this.

Any technology is redundant without the **degree of accuracy** required for useful results. In parallel with the development of sound level meters, standards have been created for each type of acoustical measurement instrument. For example, the Standards IEC 651, IEC 804 and IEC 1043 and their national equivalents give minimum requirements with respect to dynamic range, linearity and frequency response of the instrument

Our systems, such as SYMPHONIE are type 1 approved in several countries. This accuracy rating applies to the use of generic computing hardware, that in practice enables **any brand of computer to be used that meets current minimum standards**. In general, a fast processor such as the Pentium® with an ample storage capacity is preferred.

1.3. Building acoustics applications

For building applications using a 01dB PC based measurement system, the following set of components is required to carry out a measurement. For example, the isolation of air born noise, shock reception levels, equipment noise or reverberation time measurements. The list below is not exhaustive and may vary from application to application.

Transducer unit (dual channel measurements in option)

- Type 1 or Type 2 condenser microphone (pre-polarised, externally polarised (200 V).
- Associated preamplifier. It should supply the polarisation voltage for the condenser microphone if required.

Accessories

- Windshield to protect the microphone for outdoors measurements.
- Extension cable for connection to the acquisition unit.
- Tripods.
- Measurement case for outdoors measurements.
- Type 1 or Type 2 acoustical calibrator to perform calibrated measurements.

Noise sources

- Pink and white noise sources in octave bands with or without a controller for air borne sound isolation measurements (type **GDB95**).
- Dodecaheader Omnidirectional noise source type **DO12**.
- Standardised tapping machine for impact noise insulation measurements (Type **N211**).
- Power amplifier **M700**
- Amplified loudspeaker connected to the output of the **SYMPHONIE** or **HARMONIE** acquisition unit in order to use the internal signal generator (white noise and pink noise).

Measurement systems

- Laptop, industrial or desktop computer, that meets the minimum requirements specified by 01dB, with a Windows operating system.
- Acquisition unit connected to the computer (type **SYMPHONIE** or **HARMONIE**).
- **dBBATI32** measurement and processing software.

The photograph opposite illustrates a 01dB buildings measurement system.

📖 *All the components listed above are available from our offices. Contact your regional sales representative for more information.*

📖 *A complete description on how to assemble the various components of your system is given in the getting started manual delivered with the system*

2. NEW FEATURES

❑ Managers

The **user interface** of **dBBATI32** has been modified for a greater ease of use.
The managers allows the operator to configure and save the settings of the measurement **system more easily and faster** as well as performing **successive measurements in batch mode**.

Three different managers are available :

- **Measurement** manager (*.**GSM**)
- **Analysis** manager (*.**GSA**)
- **Standard calculation** manager (*.**GSC**)

All display, acquisition and calculation parameters are saved with a given manager

These managers therefore offer a simple and efficient mean to save in **a single file all the parameters of a measurement sequence**. For example, a measurement file insulation.GSM may contain all the acquisition parameters for emitted noise, received noise, background noise and reverberation time measurements.

Example of computation manager

Example of measurement manager

📖 ***Refer to chapter 6 for further information on the use of these managers***

❑ Quick access to off-line calculations using icons

The operations that can be performed off-line to items of a measurement session can now be accessed directly using the icons of the measurement session toolbar, avoiding the use of the computation server for these simple calculations.

The icons shown aside can be used when compatible items of a measurement session are selected.

These icons allows the operator to perform the following operations :

- **Addition** of items
- **Subtraction** of items
- **Averaging** of items
- **Frequency recombination** in octave bands
- **RT computation** from a time decay item

📖 ***Refer to paragraph 15.2.8 for further information.***

❑ Simplified and Standard user levels

In standard mode, all the functions of the software package may be accessed. **It is possible to access to the simplified version of the software by using a command of the Preferences menu.**

This version offers a simplified user interface to the operator, but some functions are not available.

📖 ***Refer to chapter 20 for further information.***

❑ Measurements

- **Measurement of equipment noise (=Maximum value in Slow A)**

The measurement of equipment noise for building acoustics applications correspond to the maximum value of the A-weighted Leq time history, using a Slow time constant, over a user-defined duration.

🕮 ***Refer to chapter 8 for further information.***

- **Measurement using the MLS technique**

The MLS method (Maximum Length Sequence) can be used for all types of measurements, excepted equipment noise. The use of this technique is througoutly explained in the chapters relative to acquisition.

🕮 ***Refer as well to annex 21.2***

- **Received noise measurements** are treated differently for **airborne** and **impact** noises

🕮 ***Refer to chapter 7 for further information.***

- **Room criteria measurements**

🕮 ***Refer to chapter 11 for further information.***

- **Pink noise generator** remotely controlled : stabilisation delay of the noise in the room under test, automatic cut-off of the generator for reverberation time measurements.

- **Delayed measurements** : User-defined delay for the operator to leave the room under test.

❑ Standard calculations

In this version of **dBBATI32**, many building acoustics standards are taken into account (calculation of ISO 717 criteria for example).

🕮 ***Refer to chapter 16 for further information.***

❑ Edition of test reports

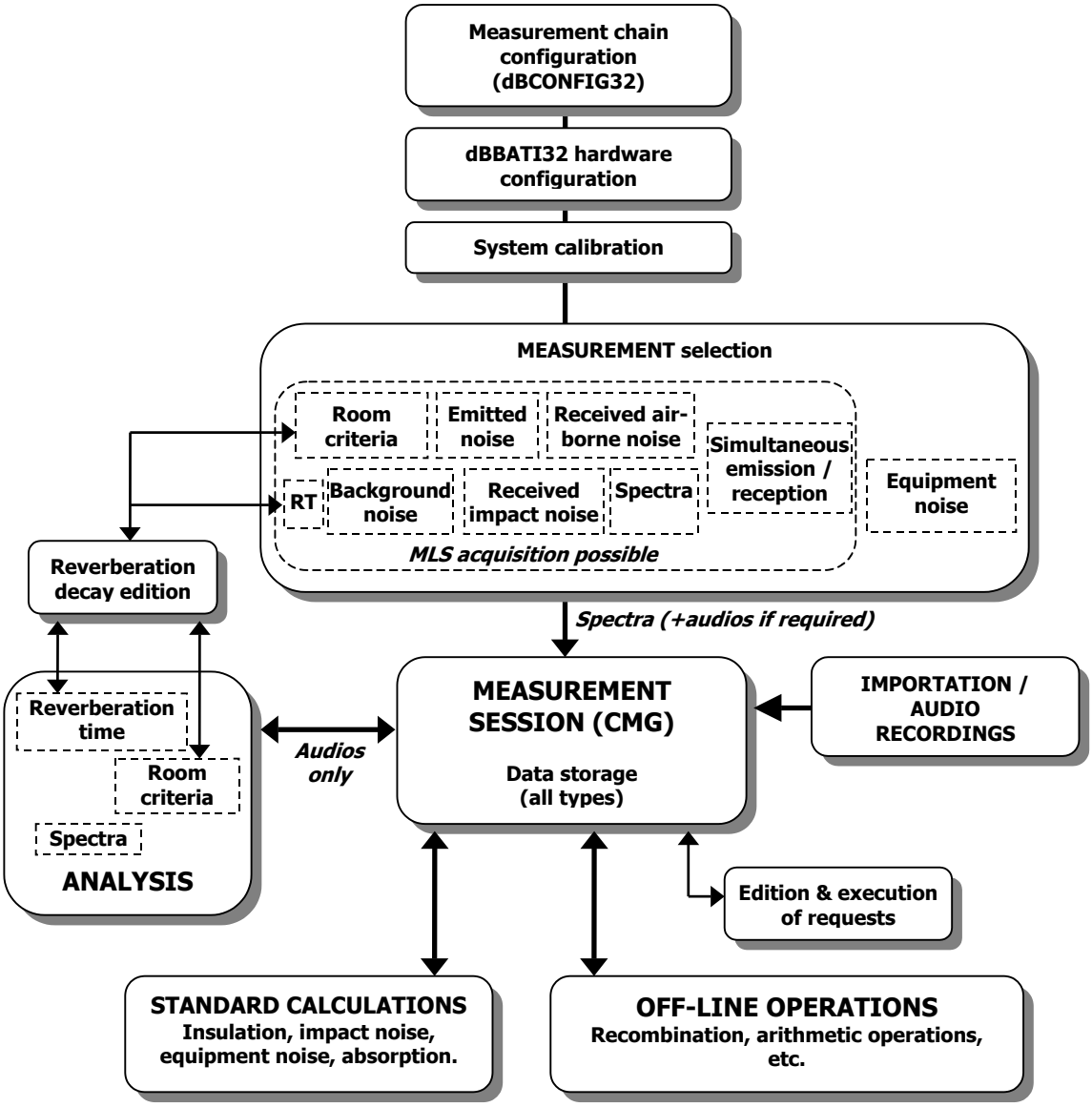
It is now possible to create, edit and print tests reports featuring standard calculations, directly from the software package.

These reports comply with the specifications of ISO standards.

🕮 ***Refer to paragraph 15.5 for further information.***

3. ACQUISITION, ANALYSIS AND COMPUTATION WITH DBBATI32

3.1. Overview of the software package : principle of operation



All data acquired, as well as any analysis result, are saved in a database called **a measurement session datafile** (of extension *.CMG).

The procedures for each type of measurement, as well as each data processing operation, are presented in the following paragraphs. The stages common to each type of measurement are also described.

Each procedure is then described in details in the different chapters of this manual.

3.2. Measuring with dBBATI32

3.2.1. Common steps

These steps have to be taken before each measurement. There are common to all the types of measurement.

- **Stage 1 : Set up of the measurement chain**

Connection of the hardware elements, definition of their characteristics in the database utility **dBCONFIG32**, set up of the signal conditioning options of both the transducer and the hardware peripheral.

- **Stage 2 : Selection of acquisition hardware: one or more transducer / calibrator pair**

Choose **Acquisition / Hardware Configuration.** Select the acquisition platform (and associated signal conditioning options), the correct transducer and calibrator pairs, etc. Refer to **chapter4.**

- **Stage 3: Calibration**

Carry out the calibration of the measurement chain before each measurement (Command **Acquisition / Calibration**). Refer to **chapter 5.**

3.2.2. Types of measurements in dBBATI32

dBBATI32 features different types of measurements, analyses and computation. The acquisition can be done :

- Either by **importation** existing audio data files (16-bit files or other 01dB application data files)
- Either by **real time acquisition**. 4 main types of real time acquisition may be identified :**spectra** measurements, **equipment noise** measurements, **Reverberation time** measurements and **room criteria** measurements.
- Either by direct **signal recording** on the computer hard disk for later analysis.

The **spectra, time decays, room criteria** and **audio recordings** obtained from each of these methods are stored in a measurement session datafile (*.CMG) to enable airborne or impact sound insulation measurements, for example.

Furthermore, each type of measurements listed above can be saved in a measurement manager (*.GSM file).

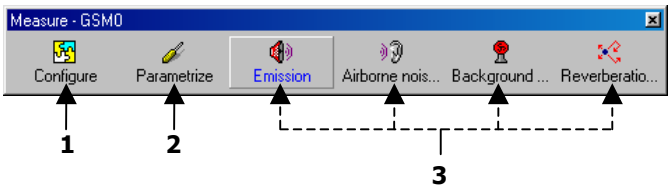
3.2.3. Spectra measurements

This type of acquisition is used for general spectra measurements in octaves and third octaves (emitted noise, received noise, background noise spectra, received airborne noise and impact noise spectra, simultaneous emitted and received noise spectra, spectra with no particular type) enabling standardised insulation calculations.

Access this type of measurement from a measurement manager by the command **Acquisition / New** or, if a measurement configuration already exists, by the command **Acquisition / Open.** Refer to **chapter 6** for further explanation on how to use a manager.

- **Step 1**

Use the command **Configure** of the manager to select the types of measurements to activate.

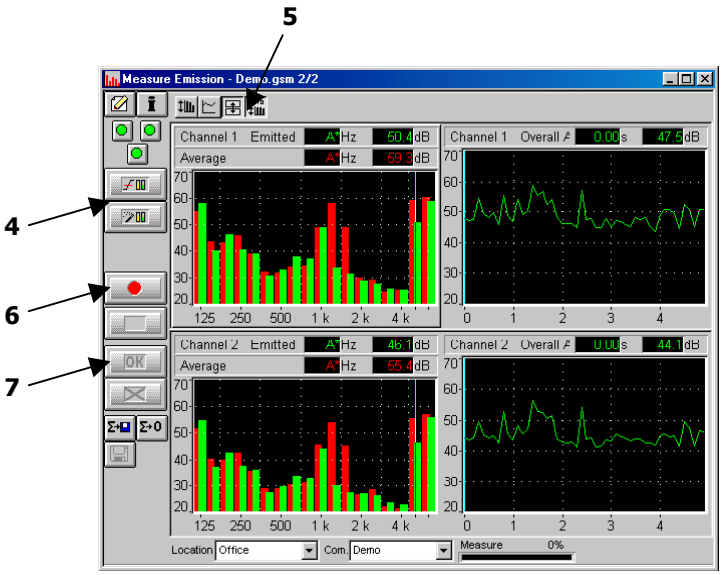


- **Step 2**

Use the command **Parametrize** to select the acquisition parameters, the generator settings, the averaging parameters, channel selection settings, etc.

- **Step 3**

Use the icons of the manager toolbar to start a given type of spectra measurement. The measurement window shown aside is displayed on screen.



- **Step 4 : Setting the dynamic range**

Use the command **Commands / Gain and threshold** or alternatively use the associated icon.

The gain settings are used to set the dynamic range for the measurement in order to eliminate over or under charge during acquisition.

The Autorange facility is used when the sound level during the measurement is fairly constant. This is usually the case for airborne sound insulation or impact sound insulation measurements. To initiate the autorange use the **Acquisition / Autorange** command or the touch key function **F8**.
Threshold levels are used to automatically trigger a measurement when a sound level (the threshold) is passed (a direction is specified).

- **Stage 5 : Setting the display parameters**

Definition of the display parameters from the **Display** menu (for optimisation the scale, display of time histories etc.). The colours of the graphs may be edited using **Preferences / Colours**.

- **Stage 6 : Starting the measurement**

Acquisition is started using the command **Acquisition / Start (F3).** Icons found within the measurement window allow the start or ending of the measurement. Passing the threshold could also start measurement. **dBBATI32** also features a pink or white noise generator when used with SYMPHONIE or HARMONIE.

- **Stage n° 7 : Validation of the results and data storage**

At the end of each measurement, the results can either be accepted or rejected. For results that are accepted, the spectra are stored in a measurement session datafile *.CMG.

Refer to chapter 7 for detailed explanations on spectra measurements.

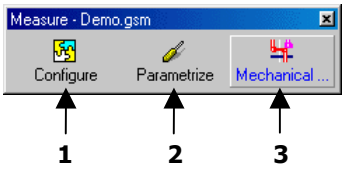
3.2.4. Equipment noise measurements

This type of acquisition is used for equipment noise measurements (maximum value of the A-weighted Leq time history, using a Slow time constant, over a user-defined duration).
Equipment noise spectra can also be saved (instantaneous spectrum at the time of the maximum A-weighted Leq value).

Access this type of measurement from a measurement manager by the command **Acquisition / New** or, if a measurement configuration already exists, by the command **Acquisition / Open.** Refer to **chapter 6** for further explanation on how to use a manager.

- **Step 1**

Use the command **Configure** of the manager to select the type of measurement **mechanical equipment noise**.

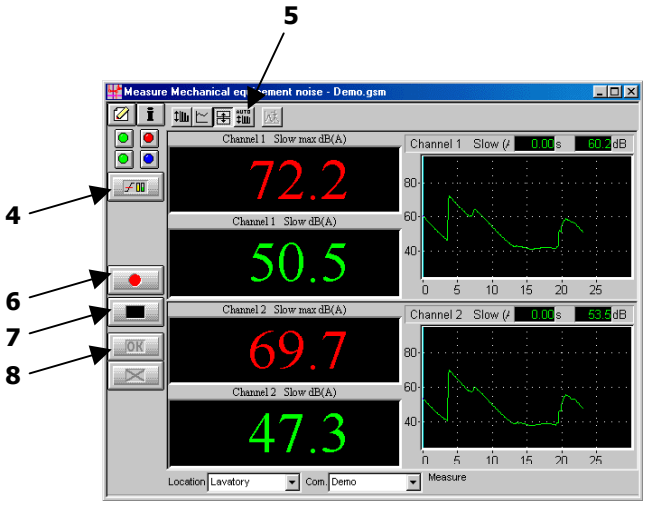


- **Step 2**

Use the command **Parametrize** to select the acquisition parameters, the generator settings, the averaging parameters, channel selection settings, etc.

- **Step 3**

Use the icon **mechanical equipment noise** of the manager toolbar to start an acquisition. The measurement window shown aside is displayed on screen.



- **Step 4 : Setting the dynamic range**

Use the command **Commands / Gain and threshold** or alternatively use the associated icon.

The gain settings are used to set the dynamic range for the measurement in order to eliminate over or under charge during acquisition.

- **Stage 5 : Setting the display parameters**

Definition of the display parameters from the **Display** menu (for optimisation the scale, display of time histories etc.). The colours of the graphs may be edited using **Preferences / Colours**.

- **Stage 6 : Start the acquisition**

When opening the measurement window, the equipment noise level is acquired and memorised. It is possible to start the measurement again (reset) by using the **Commands / Start (F3).**

- **Stage 7 : End of acquisition**

The maximum value of the A-weighted Slow Leq is displayed on screen for validation since the latest reset.

- **Stage 8 : Validation of the results and data storage**

At the end of each measurement, the results can either be accepted or rejected. If an extraneous noise source affects the measurement result (for example, a door slamming), the user may manually adjust the equipment noise level by using the cursor on the time history plot.
For results that are accepted, the spectra are stored in a measurement session datafile *.CMG.

Refer to chapter 8 for detailed explanations on equipment noise measurements.

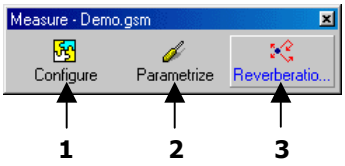
3.2.5. Reverberation time measurements

This provides complete reverberation duration calculation enabling normalised insulation spectra calculations absorption indices, etc.

Access this type of measurement from a measurement manager by the command **Acquisition / New** or, if a measurement configuration already exists, by the command **Acquisition / Open.** Refer to **chapter 6** for further explanation on how to use a manager.

- **Step 1**

Use the command **Configure** of the manager to select the type of measurement **reverberation time**.

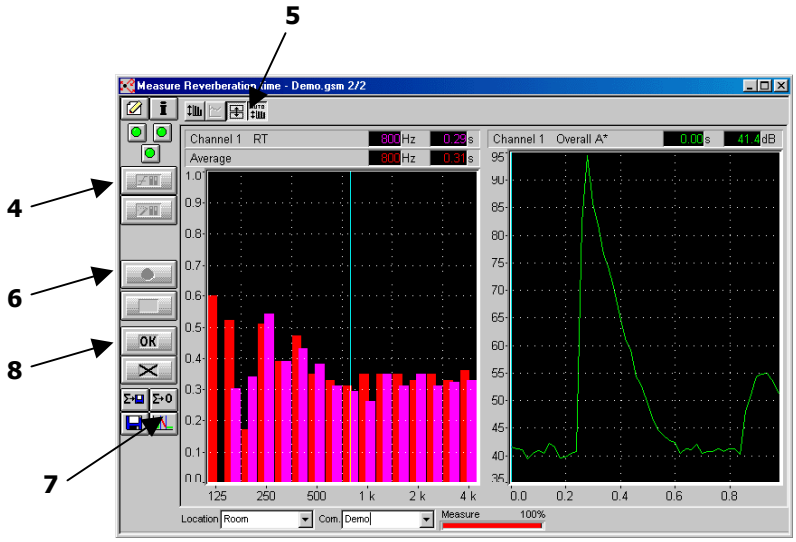


- **Step 2**

Use the command **Parametrize** to select the acquisition parameters, the generator settings, the averaging parameters, etc

- **Step 3**

Use the icon **reverberation time** of the manager toolbar to start an acquisition. The measurement window shown aside is displayed on screen.



- **Step 4 : Setting the dynamic range**

Use the command **Commands / Gain and threshold** or alternatively use the associated icon.

The gain settings are used to set the dynamic range for the measurement in order to eliminate over or under charge during acquisition.

The Autorange facility is used when the sound level during the measurement is fairly constant. This is usually the case for reverberation time measurements using a stationary signal. To initiate the autorange use the **Acquisition / Autorange** command or the touch key function **F8**.
Threshold levels are used to automatically trigger a measurement when a sound level (the threshold) is passed (a direction is specified).

- **Stage 5 : Setting the display parameters**

Definition of the display parameters from the **Display** menu (for optimisation the scale, display of time histories etc.). The colours of the graphs may be edited using **Preferences / Colours**.

- **Stage 6 : Starting the measurement**

Acquisition is started using the command **Acquisition / Start (F3).** Icons found within the measurement window allow the start or ending of the measurement. Passing the threshold could also start measurement. **dBBATI32** also features a pink or white noise generator when used with SYMPHONIE or HARMONIE.

- **Stage 7 : Decay editing**

Editing at the end of measurement is possible for time decays whose slope allows reverberation time spectra calculations. The decays edition window is automatically displayed on screen by default.

- **Stage n° 8 : Validation of the results and data storage**

At the end of each measurement, the results can either be accepted or rejected. For results that are accepted, the spectra are stored in a measurement session datafile *.CMG.

Refer to chapter 9 et 10 for detailed explanations on RT spectra measurements.

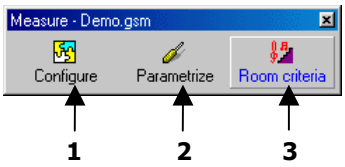
3.2.6. Room criteria measurements

This type of acquisition is used for complete measurement of room criteria (RT, EDT, Clarity, Definition, ST1, RASTI, STI).

Access this type of measurement from a measurement manager by the command **Acquisition / New** or, if a measurement configuration already exists, by the command **Acquisition / Open.** Refer to **chapter 6** for further explanation on how to use a manager.

- **Step 1**

Use the command **Configure** of the manager to select the type of measurement **room criteria**.

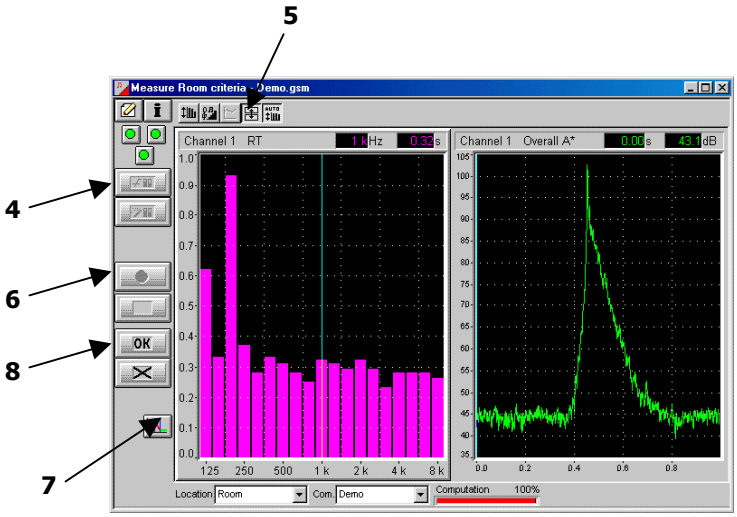


- **Step 2**

Use the command **Parametrize** to select the acquisition, signal and computation parameters, the averaging parameters, etc.

- **Step 3**

Use the icon **room criteria** of the manager toolbar to start an acquisition. The measurement window shown aside is displayed on screen.



- **Step 4 : Setting the dynamic range**

Use the command **Commands / Gain and threshold** or alternatively use the associated icon.

The gain settings are used to set the dynamic range for the measurement in order to eliminate over or under charge during acquisition.

To initiate an autorange use the **Acquisition / Autorange** command or the touch key function **F8**. Threshold levels are used to automatically trigger a measurement when a sound level (the threshold) is passed (a direction is specified).

- **Stage 5 : Setting the display parameters**

Definition of the display parameters from the **Display** menu (for optimisation the scale, display of time histories etc.). The colours of the graphs may be edited using **Preferences / Colours**.

- **Stage 6 : Starting the measurement**

Acquisition is started using the command **Acquisition / Start (F3).** Icons found within the measurement window allow the start or ending of the measurement. Passing the threshold could also start measurement.

- **Stage 7 : Decay editing**

At the end of each measurement, the user may edit the slope of the time decays in each frequency band and set up the arrival of the direct wave. These settings have a non-neglectable effect on the calculation of room criteria. The decays edition window is automatically displayed on screen by default.

- **Stage n° 8 : Validation of the results and data storage**

At the end of each measurement, the results can either be accepted or rejected. For results that are accepted, the spectra are stored in a measurement session datafile *.CMG.

Refer to chapter 11 and 12 for detailed explanations on room criteria measurements.

3.2.7. Signal recording

This command (**Acquisition / record**) useful to record audio signals for later frequency analysis. It can be used as a DAT recorder.

❑ **Stage 1 : Define the acquisition process**

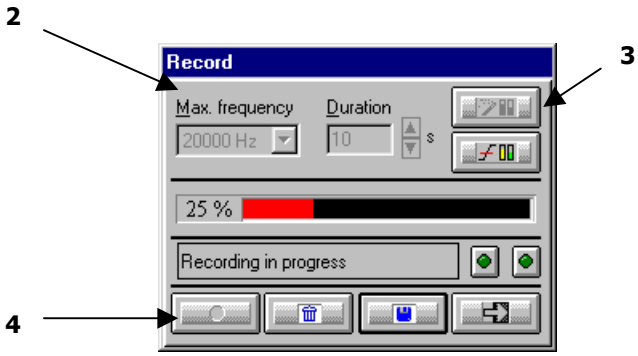
In the **Acquisition** menu, select the command **Record configuration** and select the rearming mode: Manual or Automatic (when a threshold trigger is used). Then, use the command **Acquisition / Record.**

❑ **Stage 2 : Acquisition parameters**

Define the acquisition frequency range as well as the maximum duration of an audio record.

❑ **Stage 3 : Gain and Threshold settings / Autorange**

Select the gain settings command, manual or automatic (autorange). These commands are used to adjust the dynamic range required for the measurement in order to eliminate surcharge and under loads during recording.



Autorange is used when the sound levels to measure do not vary greatly over the acquisition duration. Threshold levels are used to automatically trigger a measurement when a threshold sound level is passed (a direction is specified).

❑ **Stage 4 : Recording Audio files**

Start the acquisition when the set-up operations have been carried out. Audio data is saved to the computer hard disk in a measurement session datafile (*.CMG).

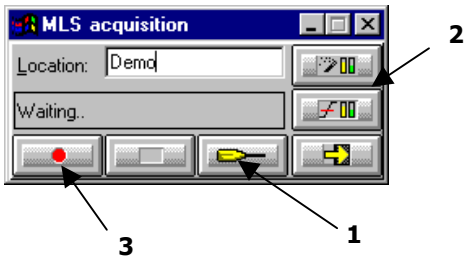
Refer to chapter 13 for detailed explanations on signal recording.

3.2.8. Acquisition en mode MLS

Use the command **Acquisition / MLS*** **acquisition mode** to start a measurement of room impulse responses.

❑ **Stage 1 : Definition of MLS acquisition parameters**

Define the parameters relative to the MLS sequence to generate and the acquisition such as the sequence order, the number of averages, and the acquisition frequency range.



❑ **Stage 2 : Gain settings / Autorange**

Select the gain setting command (automatic or manual).
These commands are used to adjust the dynamic range required for the measurement in order to eliminate surcharge and under loads during recording. Autorange is used when the sound levels to measure do not vary greatly over the acquisition duration.

❑ **Stage 3 : Impulse response recordings**

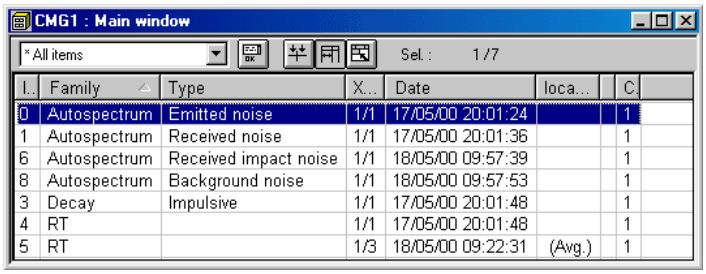
Start the acquisition when the set-up operations have been carried out. Impulse responses are saved to the computer hard disk in a measurement session datafile (*.CMG) as an **impulse response** item.

Refer to chapter 14 for detailed explanations on MLS acquisition

* MLS : Maximum Length Sequence

3.3. Data processing in dBBATI32

Data processing in **dBBATI32** can now be performed with **analysis and computation managers.** The first action for data analysis is to open an existing measurement session (command **File / Open**) that contains the measurement data items to analyse.

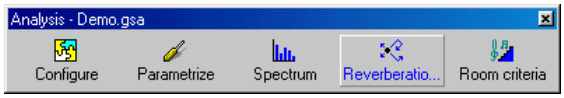


I..	Family	Type	X...	Date	loca...	C
0	Autospectrum	Emitted noise	1/1	17/05/00 20:01:24		1
1	Autospectrum	Received noise	1/1	17/05/00 20:01:36		1
6	Autospectrum	Received impact noise	1/1	18/05/00 09:57:39		1
8	Autospectrum	Background noise	1/1	18/05/00 09:57:53		1
3	Decay	Impulsive	1/1	17/05/00 20:01:48		1
4	RT		1/1	17/05/00 20:01:48		1
5	RT		1/3	18/05/00 09:22:31	(Avg.)	1

- **Analysis of audio records**

dBBATI32 allows one to perform three types of analysis on audio records : spectra analysis, **RT** analysis and **room criteria** analysis.

These analyses can be configured and performed with the help of the analysis manager (**Analysis** menu).



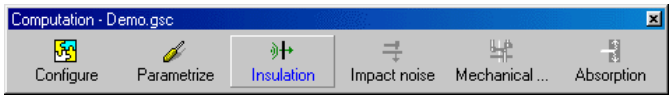
Analyses can performed successively in an automatic manner for several audio signals, using the batch mode.

Refer to chapter 16, 17 and 18 for detailed explanations on audio data analysis.

- **Standardised calculations**

In this version of **dBBATI32**, several standard indices may be computed directly using the computation manager.

4 different types of computation are available (Standard calculations menu) : **Insulation, Impact noise, Mechanical equipment noise and absorption.**



Standardised calculations may be performed successively in an automatic manner over several items using the batch mode.

Refer to chapter 16 for detailed explanations on standardised calculations.

The tables shown below features all the indices computed in dBBATI32 as well as the standard it refers to.

Airborne noise (insulation)

Raw level difference D Standardised level difference DnT A weighted standardised level difference DnAT	French standard NF S 31-057
Raw insulation D Normalised sound insulation Dn Standardised sound insulation Dn,T	International standard ISO 140-4
Weighted normalised sound insulation Dn,w Weighted standardised sound insulation Dn,T,w	International standard ISO 717-1
Sound reduction index R	International standard ISO 140-3 (NF EN 140-3)
Apparent sound reduction index R'	International standard ISO 140-4 (NF EN 140-4)
Weighted sound reduction index Rw Weighted apparent sound reduction index R'w	International standard ISO 717-1 (NF EN 717-1)

Impact noise

Normalised impact sound pressure level LnT A-weighted normalised impact sound pressure level LnAT	French standard NF S 31-057
Normalised impact sound pressure level Ln Normalised impact sound pressure level L'n Standardised impact sound pressure level L'nT	International standard ISO 140-6 and ISO 140-7
Weighted normalised impact sound pressure level Ln,w Weighted normalised impact sound pressure level L'n,w Weighted standardised impact sound pressure level L'nT,w	International standard ISO 717-2

Mechanical equipment noise

Normalised equipment noise level LeT	French standard NF S 31-057

Absorption

Absorption coefficient αs	International standard ISO 354 (NF EN 20354)
Weighted sound absorption index αw	International standard ISO 11654 (NF EN 11654)

- **General management of measurement session datafiles**

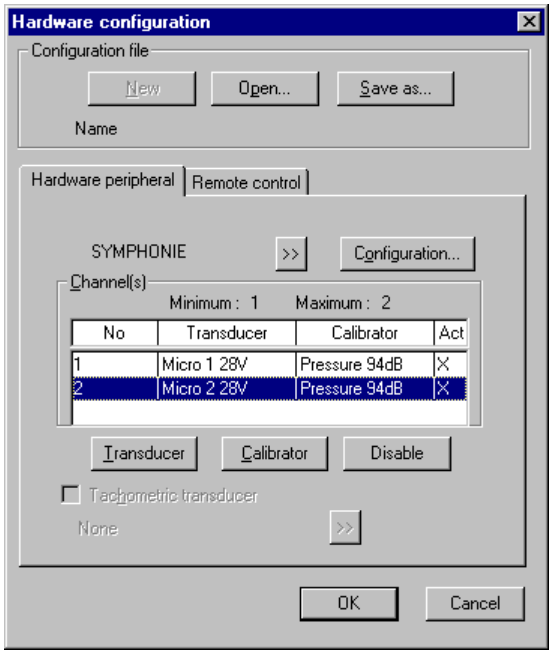
Data processing in **dBBATI32** can now be performed in a global manner thanks to the implementation of analysis scripts. Refer to **chapter 14** for details on the procedures allowing the user :

- To generally manage measurement session datafiles (open, save, close, print, copy/paste, etc…)
- To edit data items in a measurement session (date, comments, type, levels, etc.)
- To perform general calculations on data items : addition, subtraction, averaging, recombination, RT computation from time decays.
- To plot or list data items.
- To edit / print / save a test report
- To sort measurement data items in a measurement session datafile
- To import 16-bit and DOS datafiles (for users of 01dB PC-based systems with 16-bit version software packages)
- To export audio/signal events at the Microsoft WAV format

4. HARDWARE CONFIGURATION

Hardware configuration cannot be performed when a measurement manager is opened

Hardware specification and settings are required before any measurement. The **Hardware configuration** option is found under the **Acquisition** menu of **dBBATI32** main window. This dialog box (see below) features various tabs: **Hardware Peripheral** is used to define which hardware elements are used to perform an acquisition (hardware peripheral, transducers, calibrators, active channels), **Remote control** is used to define and configure a remote control object.



From the **hardware peripheral** tab, define:

- The type of hardware platform
- The active measurement channels
- For each channel, a couple transducer / calibrator of same type
- The signal conditioning options of the selected hardware peripheral (**Configuration** key)

The hardware configuration defined here will be recalled automatically next time the program is used.

The acquisition platforms, transducers and calibrators are selected from hardware elements' databases defined under the hardware configuration programme **dBCONFIG32.**

Access to tachometric transducers is only available in dBFA32.

- **Hardware**

The hardware board configuration sets up the computer so that it will be able to record data generated by the specified board. It sets the number of possible active channels. The Configuration key gives access to signal conditioning options, built-in the hardware unit.

- **Active channels**

Among the possible channel(s) available on the acquisition unit, define which channels will be active for both acquisition and calibration.

- **Transducer**

The transducer configuration loads the transfer function of the selected transducer and allows the conversion of measured data into an input voltage and the reverse process after data analysis to display the results. A transducer must be prescribed to each active channel.

- **Calibrator**

The calibrator configuration allows the user to perform the calibration routine, which adjusts the transfer function of the transducer in order to perform calibrated and accurate measurements. A calibrator must be declared for each active channel.

To enable direct power supply of a transducer from a SYMPHONIE or HARMONIE unit or a JAZZ acquisition card, define the same option(s) for the transducer(s) and for the hardware platform (Configuration command).

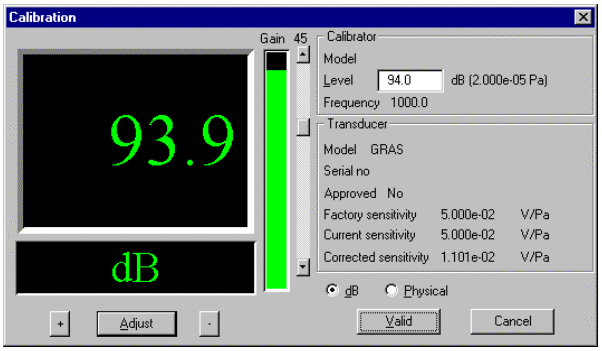
For more information concerning hardware configuration, refer to the getting started manual delivered with your measurement system.

5. MEASUREMENT CHAIN CALIBRATION

Calibration is recommended before every measurement. Calibration guarantees the reliability of the results.

Calibration affects the sensitivity of the selected transducer by adjusting it as a function of measured and expected values (defined by the frequency and level characteristics of the calibrator). The calibrators and transducers are defined by using **dBCONFIG32** and they are selected using the **Hardware configuration** command in the **Acquisition** menu.

The current calibration is done using Leq over a 125-millisecond period. It measures the Leq value of the input signal and converts it into the unit set in the transducer's characteristics. By adjusting the level to the expected level, it changes the sensitivity of the transducer. By validating it, the adjusted value will now become the default value for the next time the program is used.



Access **Calibration** via the **Acquisition** menu.

The input gain and transducer sensitivity may be calibrated from the control panel Values may be modified using the '+', '-' and 'Adjust' buttons.
Calibration levels can be expressed either in **dB** or in **physical** units.

On validation, the system is ready to carry out calibrated measurements.

Caution! Before calibration:

- Verify that the calibration signal remains constant for a sufficiently long period.
- Verify that the gain view meter is correctly positioned (neither too weak, nor overloading).
- It is preferable to place the calibrator on foam to reduce the effect of vibrations.

Caution! After calibration:

- If, for the same transducer / calibrator pair, the sensitivity after calibration differs greatly from the original sensitivity, damage to the microphone may have occurred.

- If the measured values are not correct but the calibration value is OK, it could mean that the sensitivity of the microphone is correct only at 1 000 Hz. Check the microphone membrane.

A microphone is very fragile equipment. A fall of 10-cm may damage the microphone membrane.
As general rule, if the measured value in dB varies by +/- 1.5 dB from the value that would be measured with the microphone according to the original sensitivity (see calibration data sheet), consider your microphone as faulty.

***Example*: For a microphone that as a factory sensitivity of 50 mV / Pa and a calibrator that delivers 94 dB at 1000 Hz.**

The microphone is able to perform correct measurements if:

- **The measured calibration level lies between 92.5 dB and 95.5 dB.**
- **The current microphone 'sensitivity lies between (around) 40 mV/Pa and 60 mV/Pa (multiply or divide the original value by a factor of 1.1885)**

For greater or lower microphone 'sensitivities, consider the microphone as faulty. Return it to your 01dB agent

6. USE OF THE MANAGERS

6.1. Introduction

dBBATI32 allows the user to quickly configure a measurement, analysis or computation and to carry out measurements in batch mode immediately, thanks to a simple and powerful user interface.

These managers are the key elements used at all time in order to perform a measurement, an analysis or standardised calculations. There are shown as toolbars, which size depend on the number of elements added by the operator.

Three different managers are available :

- **Measurement** manager (*.**GSM**)
- **Analysis** manager (*.**GSA**)
- **Standard calculation** manager (*.**GSC**)

Example of measurement manager

Only one manager of each type can be opened at the same time, but the contents of each one can be customised by the user.

Use the commands of the menus **Acquisition, Analysis and Standard calculations** to create, open and save different types of managers (in standard version).

- **Saving a manager**

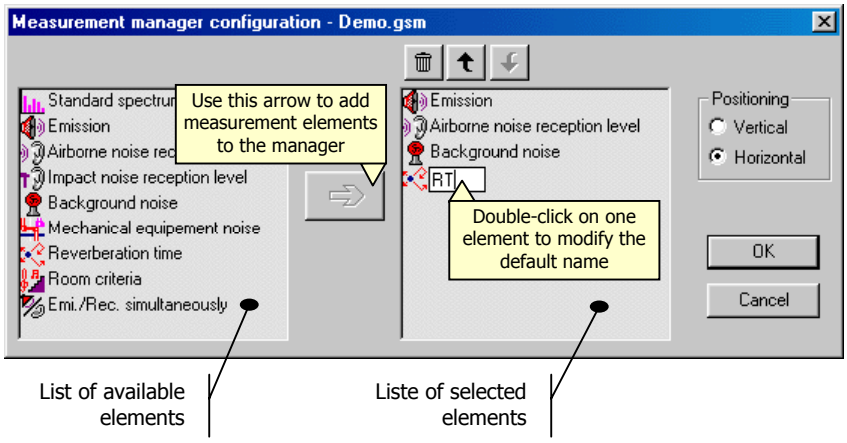
All display, acquisition and calculation parameters are saved with a given manager.
Use respectively the command **Acquisition / Save As**, **Analysis / Save As** and **Standard calculations / Save As** to save the 3 different types of managers

These managers therefore offer a simple and efficient mean to save in **a single file all the parameters of a measurement sequence**. For example, a measurement file insulation.GSM may contain all the acquisition parameters for emitted noise, received noise, background noise and reverberation time measurements.

6.2. Configuration of a manager

The number of elements contained in a given manager can be user-defined. Use the icon

Configure of a manager to open the dialog box shown below :



Select one or several elements in the list on the left and use the arrow to add it to the list of selected elements on the right. The list of selected elements will be shown in the manager toolbar. Identical available elements can be added several times to the list of selected elements.

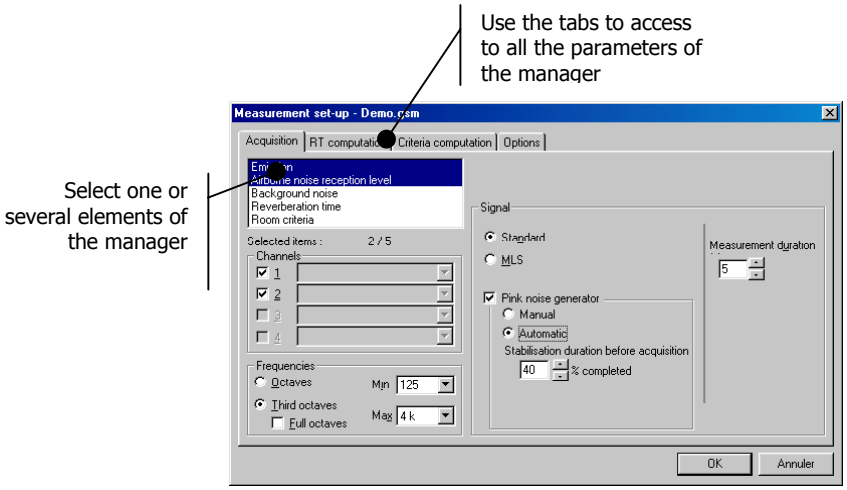
It is also possible to select the positioning of the manager toolbar and the order of the elements in the toolbar. On validation, the manager toolbar is updated.

6.3. Set-up of a manager

Use the icon

Parametrize of a given manager to access the dialog box containing all acquisition, analysis and computation parameters.

The dialog box shown below allows one to set-up the parameters of a given element of a manager and to define common parameters to all elements of the manager as well.



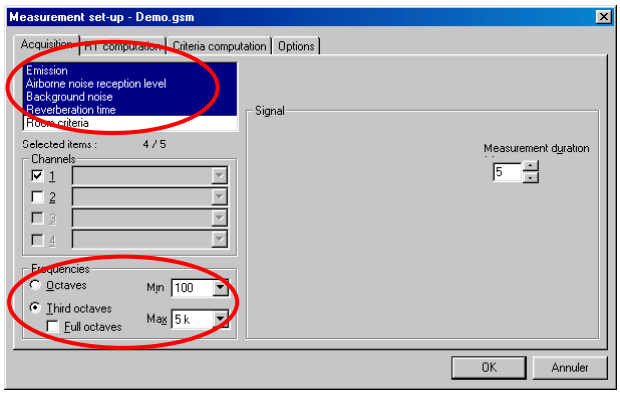
- **Common settings** for one, several or all elements of a manager can be performed by selecting multiple elements in the list (using the **Ctrl** key while selecting elements with the mouse).

Example (measurement manager)

If the acquisition frequency range must be the same for all measurement, proceed as follow to set-up the measurement manager.

Select all elements in the list (upper left-hand corner) with the mouse, and the CTRL key pushed down.

Only the settings common to all elements can then be accessed. Select the frequency range of acquisition for all the selected elements.



Simultaneous set-up of the frequency range for all elements.

📖 ***Refer to the chapter dealing with measurement, analysis and standard calculations for more explanations on the parameters to select for a given measurement.***

7. SPECTRA MEASUREMENTS

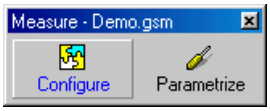
This chapter deals with spectra measurements, such as the ones listed below :

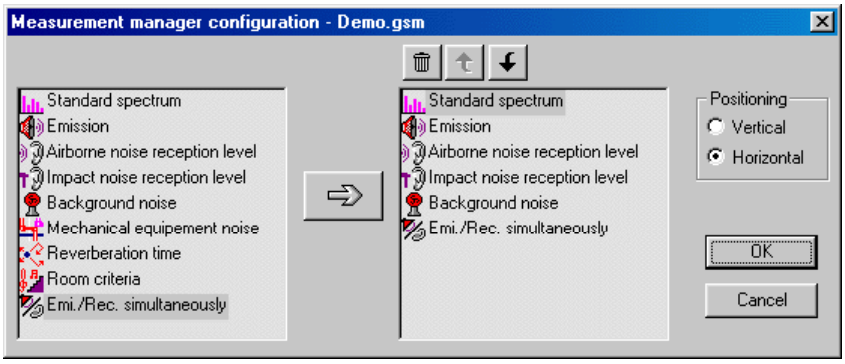
- **Standard spectrum**
- **Emitted noise**
- **Received airborne noise**
- **Received impact noise**
- **Background noise**
- **Simultaneous emission and reception**

The characteristics of these types of measurements are very similar, even if some functions cannot be accessed for particular cases (for example, the pink noise generator or the MLS acquisition mode).

This chapter presents in a general manner how to set-up and perform spectra measurements.

Use the command **Acquisition / New** to open a new measurement manager. This manager is used to select which measurement will be performed and to configure the acquisition parameters of each one of them.

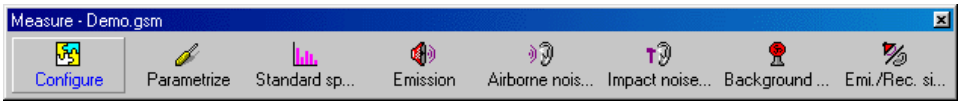




Click on **Configure** to select which elements will be added to the manager.

In this chapter, we select each type of spectrum measurements that can be done.

The manager toolbar then looks like this:

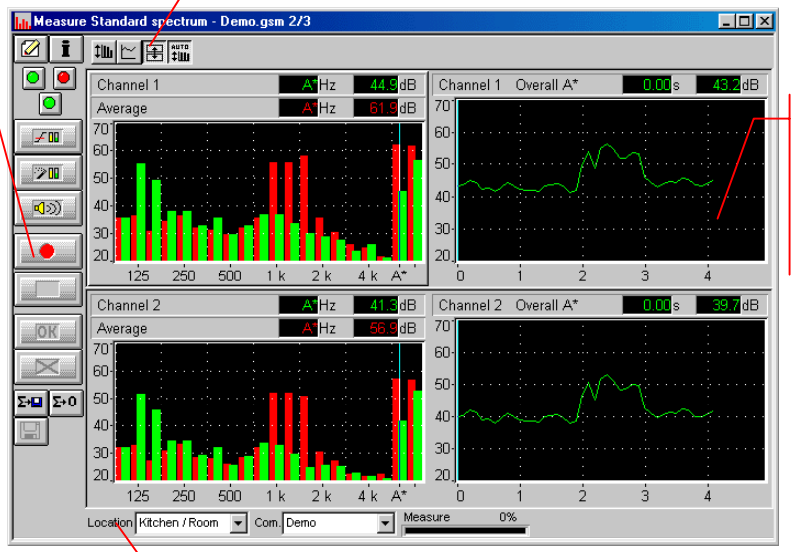


*Refer to **chapter 6** for more information on how to use the managers in **dBBATI32**.*

All the display and acquisition parameters can be saved in a measurement manager file (*.GSM) by using the command **Acquisition / Save As**.

7.1. Measurement window overview

All measurement window can be accessed from the icons of the manager toolbar. An example of spectra measurement window is given below:


Display parameters' toolbar : curves to display, autoscale, time history, etc.
Command toolbar : acquisition parameters, averaging parameters, gains, threshold, start , stop measuring, etc…
Display acquired data with cursors' values and references
Measure Standard spectrum - Demo.gsm 2/3
Channel 1
Average
Channel 1 Overall A*
Channel 2
Average
Channel 2 Overall A*
Location
Kitchen / Room
Com.
Demo
Measure
0%
Status bar : state and information about the acquisition process

The measurement configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

Definition of the measurement identifier (location and comment)

Show/hide information table

Overloads and threshold exceedance display.

The upper part shows overload LEDs (instantaneous on the left, max hold on the right).
The lower part shows a threshold exceedance LED (see **paragraph 7.2.5**).
Reset LEDs indication by a simple click on it

Define gain and threshold parameters

Perform an automatic gain adjustment (autorange)

Start / Stop the noise generator. if the generator option has been activated (See **paragraph 7.2.3**)

Start the acquisition process

Stop the acquisition in progress

Validate current results and store them in a measurement session datafile

Cancel current results and start again

The following icons are displayed if averaging conditions are set at the acquisition parameters' stage (See **paragraph 7.2.4.2**).

Store the current averaged spectra in a measurement session datafile

Reset the current averaged spectra

Save results in a measurement session datafile

The display type and the display parameters of the active curves are controlled using the **horizontal toolbar**:

Automatic re-scaling of the spectra and time history plots

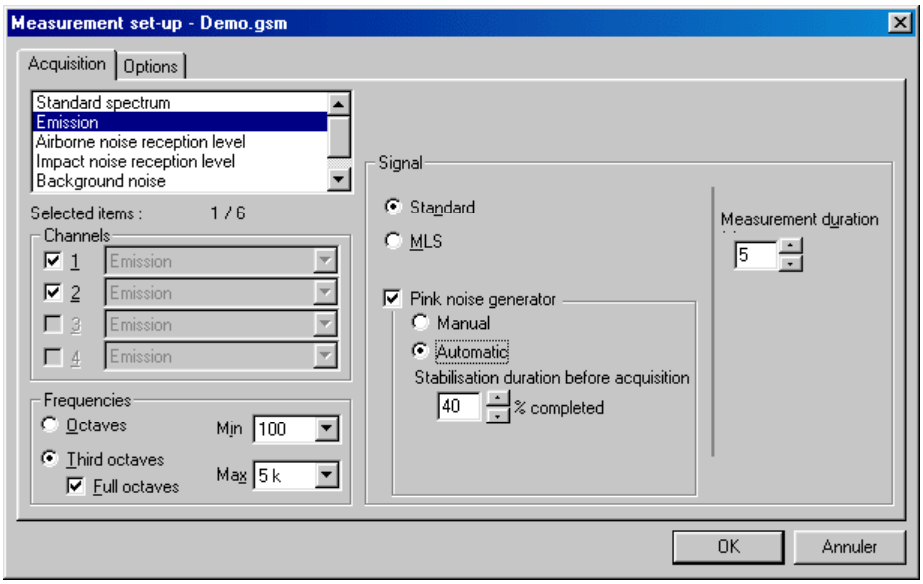
Enable or disable display of the time history plot and select the frequency band to monitor

Enable or disable linked amplitude scales of plots for each active measurement channel

Perform an automatic autoscale to adjust data display at the end of the measurement.

7.2. Measurement set-up

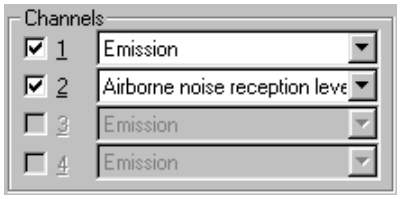
Measurement set-up can be done by pressing the key **Parametrize** of the manager. The dialog box shown below appears on screen :



*The above settings are for measurement of an emitted noise spectrum. The set-up process will however be the same for other types of spectra measurements. Refer to **chapter 6** for more information on how to use the managers.*

***Received impact noise :** MLS and Pink noise generator options are not available.*
***Background noise :** Pink noise generator option not available.*

7.2.1. Acquisition channel types for spectrum measurement

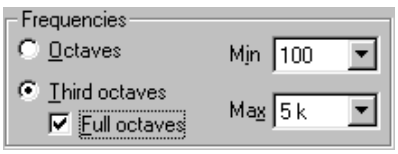


Define the active measurement channels (the acquisition platform input lines) that will be used for spectrum acquisition. Note that only channels that have been enabled in the hardware configuration dialogue box may be selected (see **chapter 4**).

The spectrum type of each channel is automatically defined as a function of the type of measurement. However, for the element «Emi. / Rec. simultaneously», it is possible to choose the channels types (Emission or Airborne noise reception level)

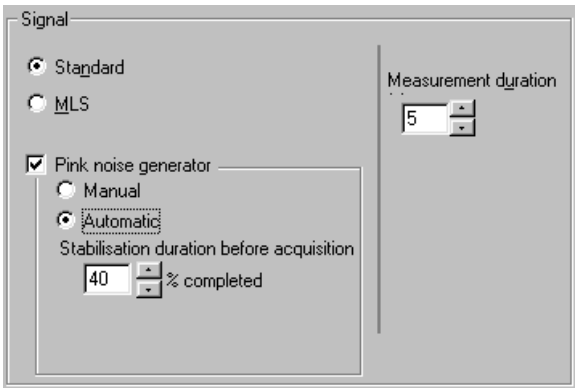
7.2.2. Analysis parameters

Choose between octave and third octave spectrum analysis and define the frequency limits for the analysis.



7.2.3. Signal characteristics

❑ Standard signal



The duration of the measurement is defined in seconds.

- **Noise generator parameters**

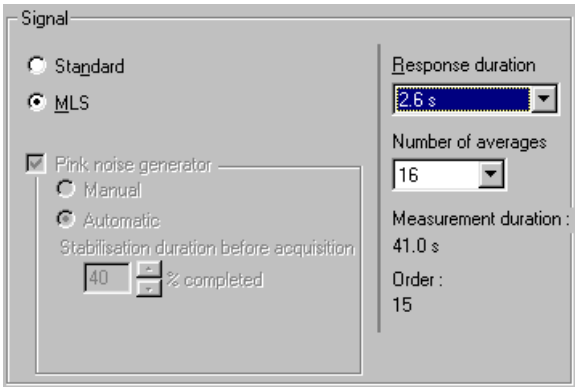
A pink noise can be generated in order to carry out emitted and / or received noise spectra measurements.
It is necessary to connect an amplified loudspeaker to the LEMO4 output socket of the SYMPHONIE or HARMONIE acquisition box.

This generator may manually activated with an icon of the measurement window or the **F11** function key.

It may also be automatically started and stopped by **dBBATI32.** To do so, tick the option automatic and define a stabilisation duration before staring the acquisition, as a function of the percentage of the complete duration of the measurement.

📖 *Refer to **paragraph 7.4** for detailed explanations on the generator state during a measurement.*

❑ MLS signal



In MLS mode (Maximum-Length Sequence), follow the following recommendations.

It is necessary to connect an amplified loudspeaker to the LEMO4 output socket of the SYMPHONIE acquisition box.

The **response duration** should be carefully selected, as it should be adapted to the geometry of the room.
Make sure that the response duration is long enough in order to obtain a background noise at the end of the measurement.

It is possible to **average** this response in order to decrease the effect of background noise. The higher the average number, the better the response quality, because the influence of random phenomena (background noise) decreases. On the other hand, the acquisition duration increases (the signal to noise ratio increase by 3 dB when doubling the number of averages.

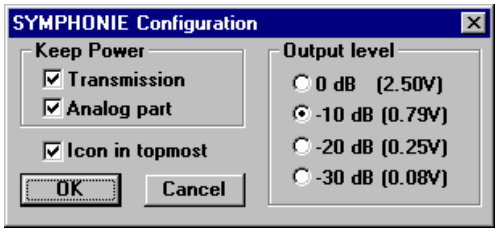
📖 ***Refer to annex 21.2.***

❑ General remark (SYMPHONIE)

The output level of the signal can be set by the SYMPHONIE icon driver from the Windows task bar

Click on the icon

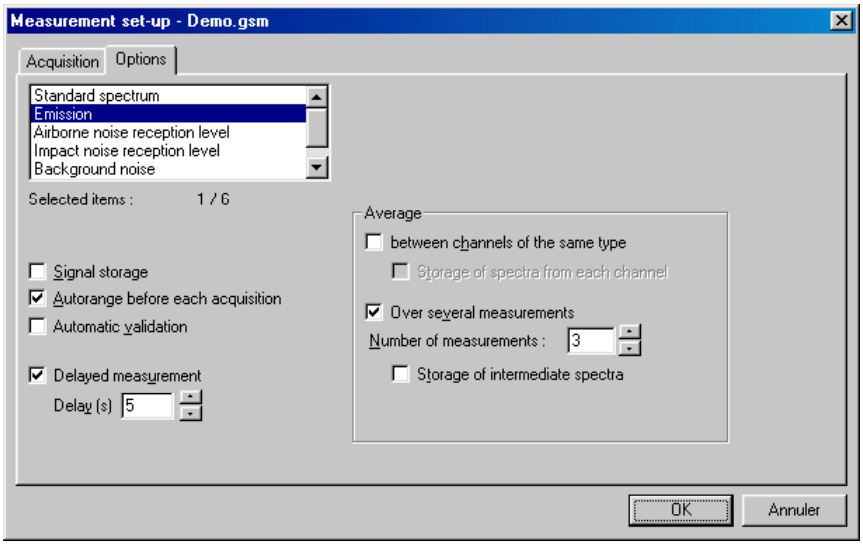
with the right of the mouse. A contextual menu appears. Choose the **Configuration** field and set the SYMPHONIE output level. The output level is changed in real time if you are playing a noise.



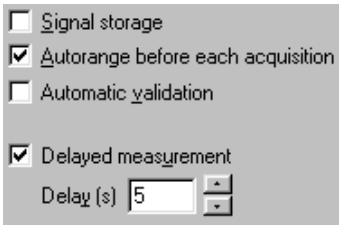
📖 *For more information on SYMPHONIE or HARMONIE (for example, connection plugs and driver configuration), consult the system installation manual..*

7.2.4. Measurement options

The configuration of measurement options and (if required) averaging options can be performed in the **Options** tab of the measurement set-up dialog box.



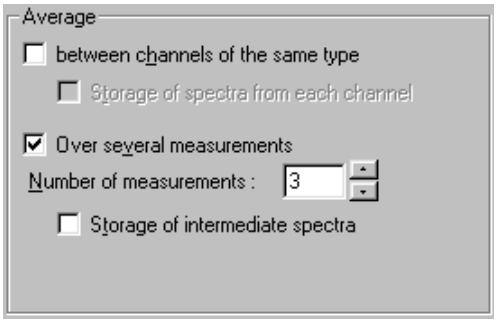
7.2.4.1.Acquisition options



- **Define if the audio signal is to be recorded to hard disc.**
  When this option is activated, the audio recording is stored in the active measurement session datafile and **dBBATI32** will use the "post-processing" mode.
- Perform an autorange automatically before each measurement
- Automatic validation of the results. Useful when averaging over several measurements.
- Define a delay before starting a measurement (so that the operator may leave the room during the measurement process.

📖 *Refer to **paragraph 7.4** for more information on the measurement process*

7.2.4.2.Averaging options


Average
between channels of the same type
Storage of spectra from each channel
Over several measurements
Number of measurements : 3
Storage of intermediate spectra

- **Averaging between channels of the same type**

One spectrum result is given for the active measurement, irrespective of the number of channels. For example, if two channels are recording emitted noise **dBBATI32** calculates the average emitted noise spectra over the two channels.

An option allows separate storage of each spectrum from each active channel.

- **Average over several measurements.**

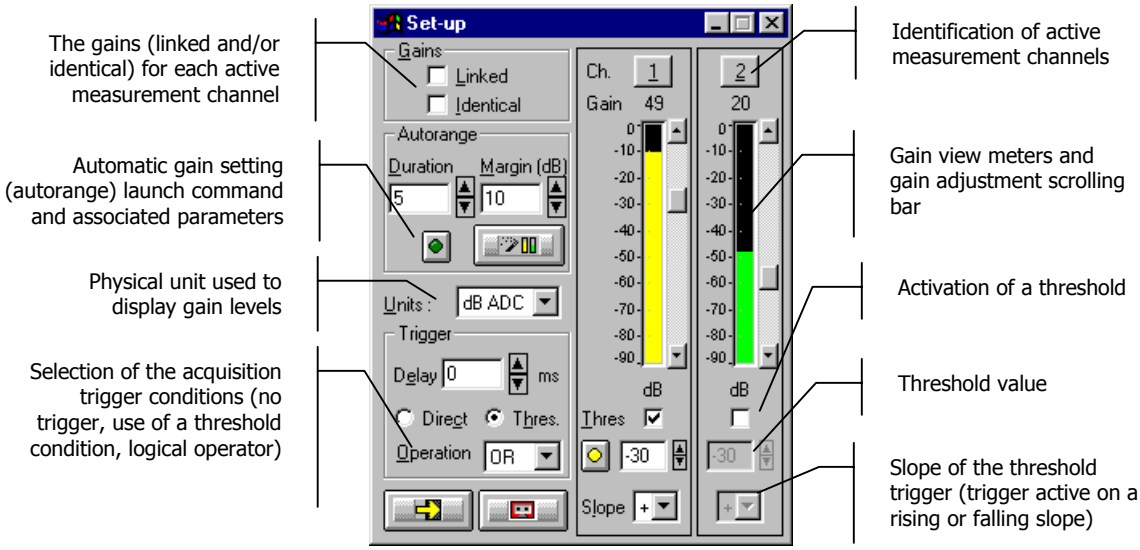
In this case, **dBBATI32** will calculate the average spectra over a sequence of measurements. It is necessary to define the number of measurements that are being considered.
The storage of intermediate spectra is also possible.

📖 *It is possible to combine the two types of averaging methods*

7.2.5. Gain and threshold command, autorange

Once the measurement set-up has been completed from the measurement manager, perform the following from within the measurement window.

Use the command **Commands / Gains and threshold**. This dialog box enables the definition of gain and threshold settings. These parameters can be used in several ways by the application software. All parameters and the available actions may be enabled or disabled according to the acquisition module, which calls this command.



❑ **Gains**

When the option **Linked** is active, the gains on all active measurement channels are modified: The gain setting of one active channel leads to identical modification on all active measurement channels.

The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

❑ **Autorange** . Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration,** defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

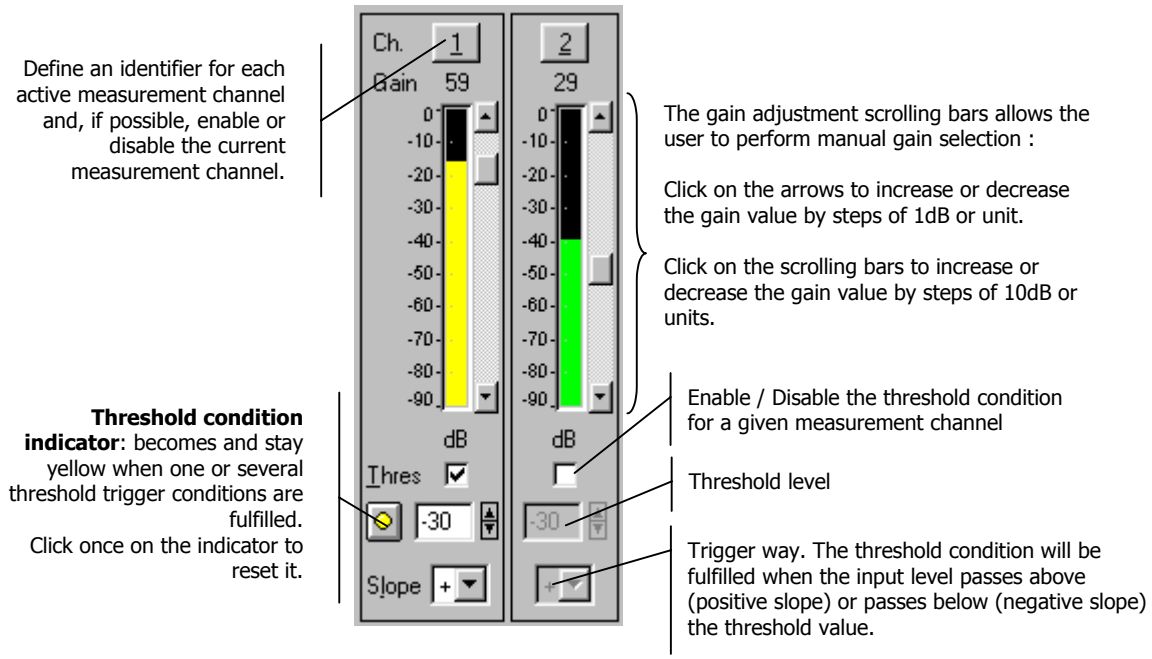
❑ **Units: Selection of the display unit of the input level.** The gain view meters may display the input levels according to three different units:

- **dB Phys**: Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **dB ADC**: Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit**: Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s^2.

❑ **Trigger:** Define here the trigger parameters used for acquisition (not available in MLS mode).

- **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.
- **Trigger delay (in ms)**: For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value
- **Operation**: Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

❑ **Channels**


Define an identifier for each active measurement channel and, if possible, enable or disable the current measurement channel.
Ch. 1
2
Gain 59
29
0 -10 -20 -30 -40 -50 -60 -70 -80 -90
dB
Thres
-30
Slope +
The gain adjustment scrolling bars allows the user to perform manual gain selection :
Click on the arrows to increase or decrease the gain value by steps of 1dB or unit.
Click on the scrolling bars to increase or decrease the gain value by steps of 10dB or units.
Threshold condition indicator: becomes and stay yellow when one or several threshold trigger conditions are fulfilled.
Click once on the indicator to reset it.
Enable / Disable the threshold condition for a given measurement channel
Threshold level
Trigger way. The threshold condition will be fulfilled when the input level passes above (positive slope) or passes below (negative slope) the threshold value.

7.3. Display set-up and status bar

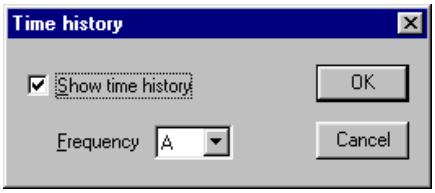
The horizontal toolbar can be used to set the graphical display parameters of the measurement window.

7.3.1. Dynamic settings

Use the command **Display / Autoscale** to automatically re-scale the plots as a function of the measured noise levels.

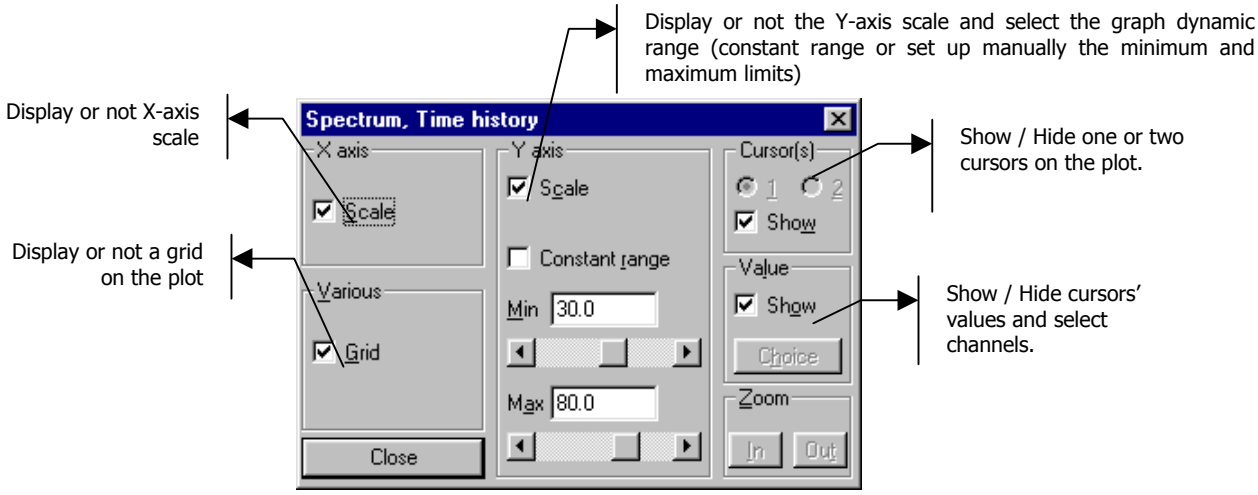
Use the command **Display / Link channels** to enable or disable linked amplitude scales of plots for each active measurement channel..

Use the command **Display / Automatic autoscale at the end of acquisition** to automatically re-scale the plots at the end of the acquisition process



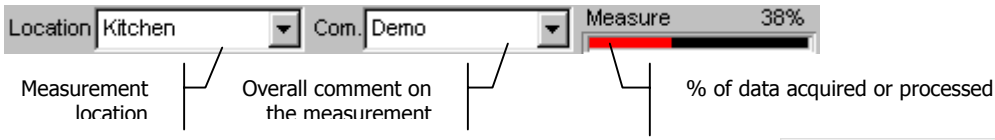
Use the command **Display / Time history** to display the time history plot and select the frequency band to monitor. The following dialog box appears on-screen.
Tick the box **Show time history** and select the **frequency** band (or overall level) to display.

Use the command **Display / Set-up** to define the display parameters of each type of data (spectra and time histories) in the measurement window. The following dialog box is displayed on screen.



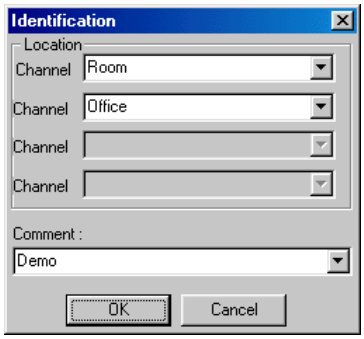
7.3.2. Status bar

The status bar allows the operator to select the measurement locations and input a general comment, either by direct input or by selection in a list, corresponding to the last 4 locations completed by the operators and the default locations.



It is possible to edit different locations for each measurement channels by using the syntax Location1 / Location2 in the edit zone. For example, the syntax Room / Office will affect the location Room to channel 1 and Office to channel 2.

This operation may be done with the command **Commands / Identifier**. The dialog shown aside is displayed on screen. Input the locations for each active channels and a general comment.



7.4. Measurement process

After measurement configuration, the user can control the measurement process with the following icons:

Start the acquisition process (F3)
The acquisition starts according to the defined acquisition and averaging parameters. When a trigger condition is defined (with the command Gain and threshold), the analyser waits for the trigger event, in order to start the measurement.

Stop an acquisition in progress (F4)

Accept current results (F7)
The measurement results are saved in a measurement session datafile.

Do not accept current results and restart the measurement (F6)

Start / Stop the pink noise generator (F11)

It is possible to generate a pink noise in order to carry out received or emitted noise spectra measurements. **See paragraph 7.2.3** on the configuration of the generator. The first press on this icon activates the generator while the second one stops it.

It is recommended to set the gain values of the acquisition platform while the generator is switched on in order to avoid overloads

The following icons are displayed if averaging conditions are set at the acquisition parameters' stage (see **paragraph 7.2.4.2**).

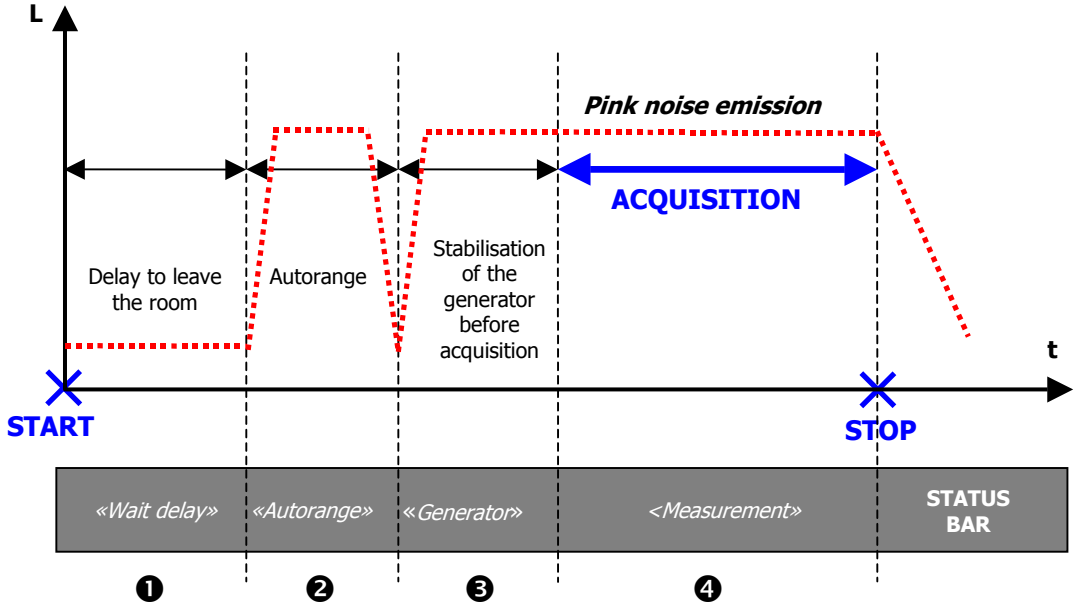
Store the current averaged spectra in a measurement session datafile

Reset the current averaged spectra

Save results in a measurement session datafile

The following sketch summarises the state of the generator and the status bar at the different stages of the acquisition process.

This process is not valid for received impact noise and background noise measurements. The states Wait delay, Autorange and Stabilisation of the generator are optional.



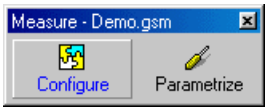
❶/❷ See paragraph 7.2.4.1 ❸ See paragraph 7.2.3

8. MECHANICAL EQUIPMENT NOISE MEASUREMENT

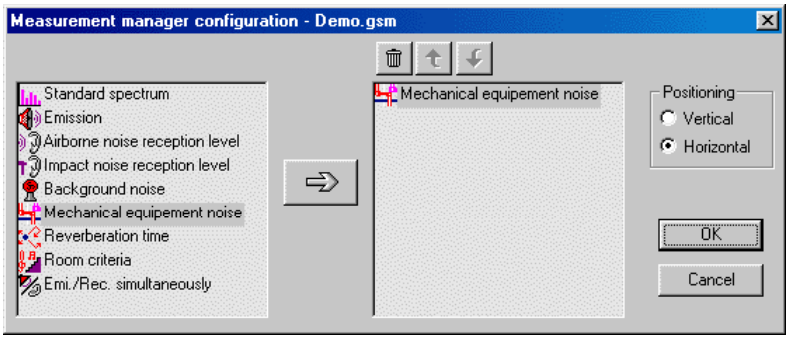
The measurement of equipment noise for building acoustics applications correspond to the maximum value of the A-weighted Leq time history, using a Slow time constant, over a user-defined duration.

Audio signal recording and internal signal generator options are not available in this mode.

Use the command **Acquisition / New** to pen a new measurement manager. This manager is used to select which measurement will be performed and to configure the acquisition parameters of each one of them.



Click on **Configure** to select which elements will be added to the manager. Select only **Mechanical equipment noise.**



The manager toolbar then looks like this:

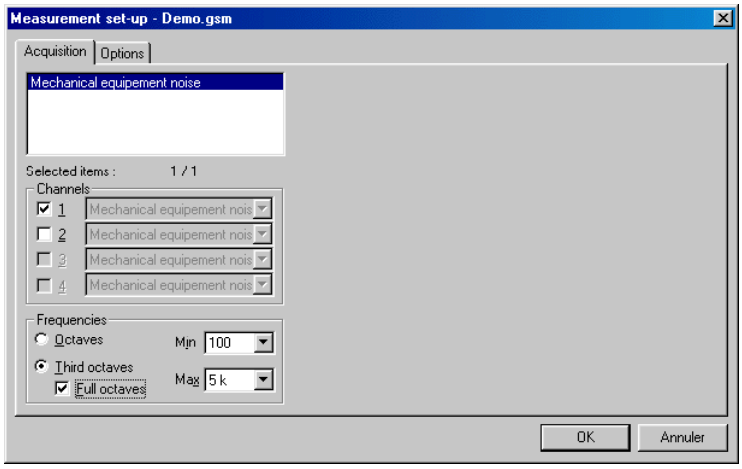
*Refer to **chapter 6** for more information on how to use the managers in **dBBATI32**.*

All the display and acquisition parameters can be saved in a measurement manager file (*.GSM) by using the command **Acquisition / Save As**.

8.1. Measurement set-up

Measurement set-up can be done by pressing the key **Parametrize** of the manager. The dialog box shown below appears on screen :

❑ Acquisition tab



- **Channels**

Define the active measurement channels (the acquisition platform input lines) that will be used for spectrum acquisition (see **chapter 4**).

- **Frequencies**

If the equipment noise spectrum is saved (in the options tab), choose between octave and third octave spectrum analysis and define the frequency limits for the analysis.

This setting does not affect the Leq measurement frequency range.

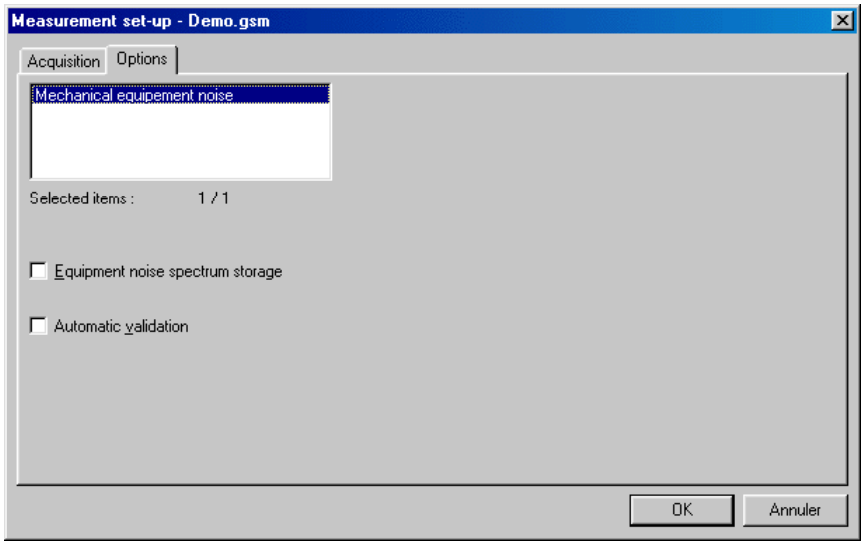
❑ Options tab

- **Storage of the spectrum**

Tick the box **Equipment noise spectrum storage** to save the mean Slow spectrum along with the measurement results (autospectrum data item).

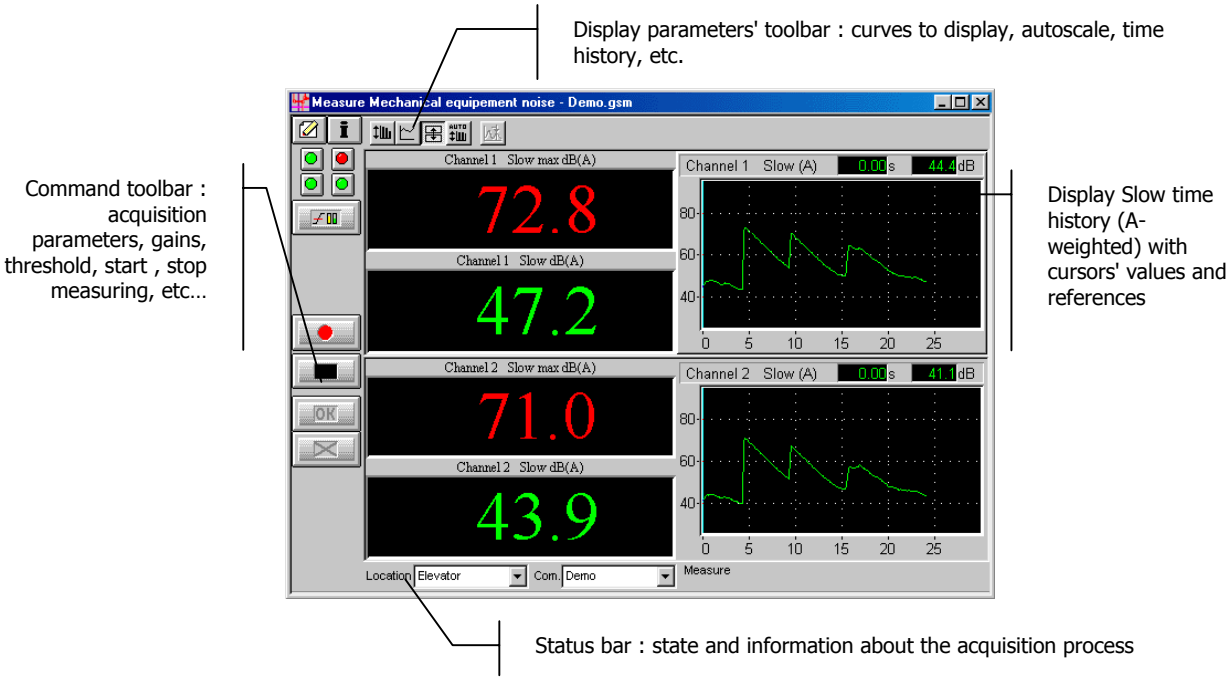
- **Automatic validation**

Tick the box **Automatic validation** for the results to be saved automatically in the measurement session datafile at the end of the acquisition.



8.2. Measurement window overview

Once the measurement set-up has been completed, start the acquisition by pressing the icon Mechanical equipment noise of the measurement manager toolbar. The following measurement window appears on screen


Display parameters' toolbar : curves to display, autoscale, time history, etc.
Measure Mechanical equipement noise - Demo.gsm
Channel 1 Slow max dB(A)
72.8
Channel 1 Slow dB(A)
47.2
Channel 1 Slow (A)
0.00s
44.4dB
Channel 2 Slow max dB(A)
71.0
Channel 2 Slow dB(A)
43.9
Channel 2 Slow (A)
0.00s
41.1dB
Location Elevator
Com. Demo
Measure
Command toolbar : acquisition parameters, gains, threshold, start , stop measuring, etc…
Display Slow time history (A-weighted) with cursors' values and references
Status bar : state and information about the acquisition process

The measurement configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

Automatic re-scaling of the spectra and time history plots

Enable or disable display of the time history plot and select the frequency band to monitor

The equipment noise level becomes equal to the cursor value.

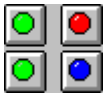
Enable or disable linked amplitude scales of plots for each active measurement channel

Perform an automatic autoscale to adjust data display at the end of the measurement.

The measurement configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

Definition of the measurement identifier (location and comment)

Show/hide information table


Overloads and underloads display

The upper part shows overload LEDs (instantaneous on the left, max hold on the right).

The lower part shows underload LEDs

Define gain parameters

Start the acquisition process – Reset all indicators and data values.

Stop the acquisition in progress

Validate current results and store them in a measurement session datafile

Cancel current results and start again

8.3. Display set-up and status bar

The horizontal toolbar can be used to set the graphical display parameters of the measurement window.

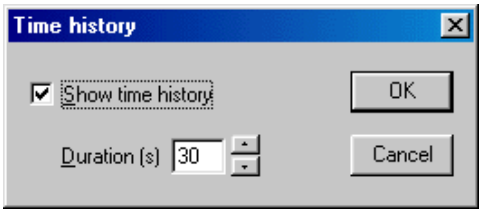
8.3.1. Dynamic settings

Use the command **Display / Autoscale** to automatically re-scale the plots as a function of the measured noise levels.

Use the command **Display / Link channels** to enable or disable linked amplitude scales of plots for each active measurement channel..

Use the command **Display / Automatic autoscale at the end of acquisition** to automatically re-scale the plots at the end of the acquisition process

8.3.2. Display time history



Use the command **Display / Time history** to display the time history plot and select the duration to monitor. The following dialog box appears on-screen.

The measurement window is updated on validation.

8.3.3. Manual determination of the equipment noise level

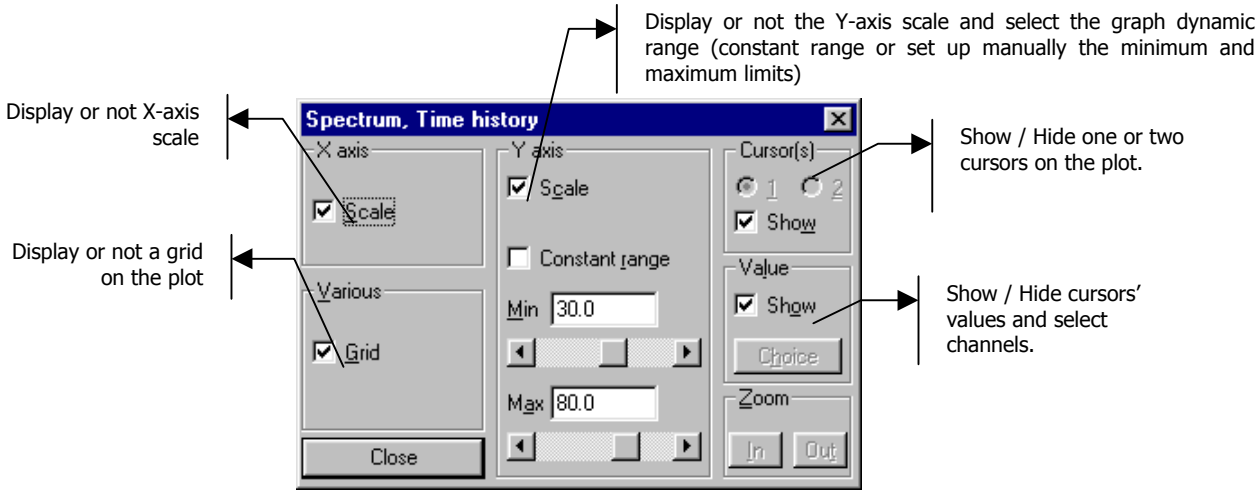
By default, it is the maximum Leq A-weighted Slow value over the complete duration of the acquisition that is considered as the equipment noise level. However, if an unwanted noise event occurred (door slamming), this value may be manually selected.

Move the cursor on the time history plot and use the command **Display / Modify equipment noise** to manually select the equipment noise level with the cursor (for the active channel). The indicators are automatically updated.

Storage of the equipment noise spectrum is not possible if this function is used.

8.3.4. Graphical settings

Use the command **Display / Set-up** to define the display parameters of each type of data (spectra and time histories) in the measurement window. The following dialog box is displayed on screen.

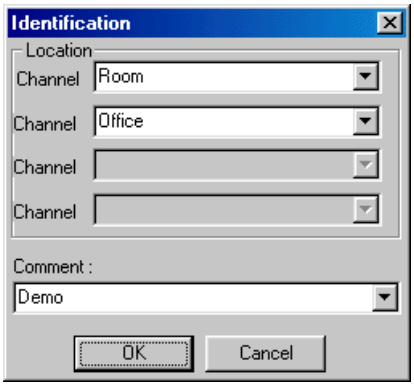


8.3.5. Status bar

The status bar allows the operator to select the measurement locations and input a general comment, either by direct input or by selection in a list, corresponding to the last 4 locations completed by the operators and the default locations.

It is possible to edit different locations for each measurement channels by using the syntax Location1 / Location2 in the edit zone. For example, the syntax Room / Office will affect the location Room to channel 1 and Office to channel 2.

This operation may be done with the command **Commands / Identifier**. The dialog shown aside is displayed on screen. Input the locations for each active channels and a general comment.



8.4. Measurement process

After measurement configuration, the user can control the measurement process with the following icons:

Start the acquisition process (F3)
The acquisition starts according to the defined acquisition parameters. From this moment, the maximum A-weighted Slow Leq value is stored. To reset the measurement, press again on this key. All indicators would be reset in this case.

Stop an acquisition in progress (F4)
The equipment noise measurement is stopped : the maximum A-weighted Slow Leq value since the last reset is displayed for validation. Calculation of the equipment noise spectrum (mean autospectrum for the selected frequency bands) is stopped.

Accept current results (F7)
The measurement results are saved in a measurement session datafile.

Do not accept current results and restart the measurement (F6)

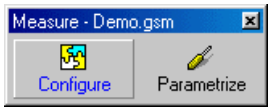
9. REVERBERATION TIME (RT) MEASUREMENTS

This chapter deals with RT spectra measurements.

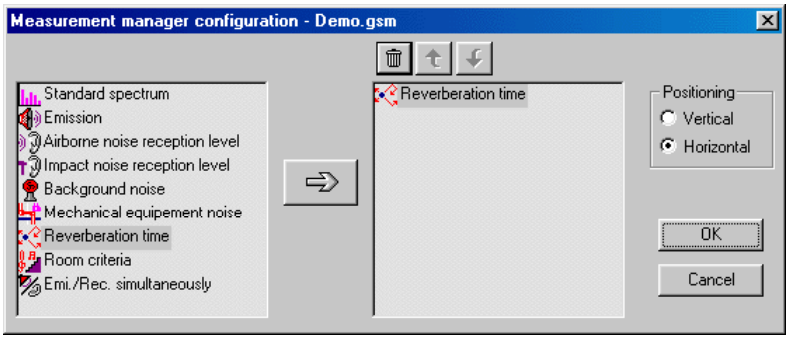
During a reverberation time measurement, **dBBATI32** creates time decay for each measurement frequency band and then applies a regression calculation algorithm in order to determine the reverberation time value in seconds (i.e. we obtain a RT spectrum).

📖 *Refer to **annex 21.3** for a detailed explanation of the RT calculation.*

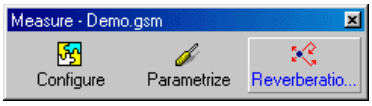
Use the command **Acquisition / New** to pen a new measurement manager. This manager is used to select which measurement will be performed and to configure the acquisition parameters of each one of them.



Click on **Configure** to select which elements will be added to the manager In this chapter, we select the type of element **Reverberation time**.



The manager toolbar then looks like this:



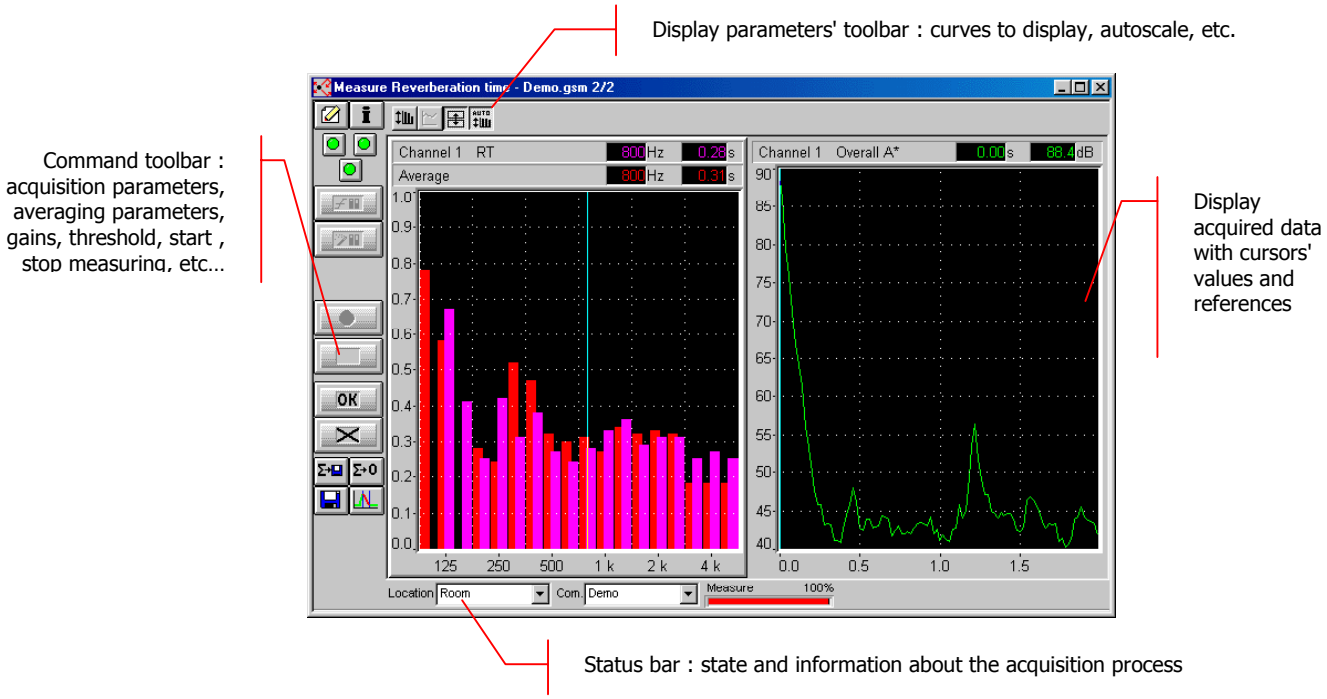
📖 *Refer to **chapter 6** for more information on how to use the managers in **dBBATI32**.*

All the display and acquisition parameters can be saved in a measurement manager file (*.GSM) by using the command **Acquisition / Save As**.

9.1. Measurement window overview

The measurement window can be accessed from the icon

Reverberation time of the manager toolbar


Display parameters' toolbar : curves to display, autoscale, etc.
Command toolbar : acquisition parameters, averaging parameters, gains, threshold, start , stop measuring, etc...
Display acquired data with cursors' values and references
Status bar : state and information about the acquisition process
Measure Reverberation time - Demo.gsm 2/2
Channel 1 RT
Average
Channel 1 Overall A*
OK
Location Room
Com. Demo
Measure
100%

The measurement configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

Definition of the measurement identifier (location and comment)

Show/hide information table

Overloads and threshold exceedance display.

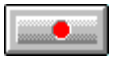
The upper part shows overload LEDs (instantaneous on the left, max hold on the right).
The lower part shows a threshold exceedance LED (see **paragraph 9.2.6**).

Reset LEDs indication by a simple click on it

Define gain and threshold parameters

Perform an automatic gain adjustment (autorange)

Start / Stop the noise generator. if the generator option has been activated (See **paragraph 9.2.3**)


Start the acquisition process

Stop the acquisition in progress

Validate current results and store them in a measurement session datafile

Cancel current results and start again

The following icons are displayed if averaging conditions are set at the acquisition parameters' stage (See **paragraph 9.2.5.2**).

Store the current averaged spectra in a measurement session datafile

Reset the current averaged spectra

Save results in a measurement session datafile

Display the time decay edition window to adjust RT spectrum values (See **chapter 10**).

The display type and the display parameters of the active curves are controlled using the **horizontal toolbar**:

Automatic re-scaling of the spectra and time history plots

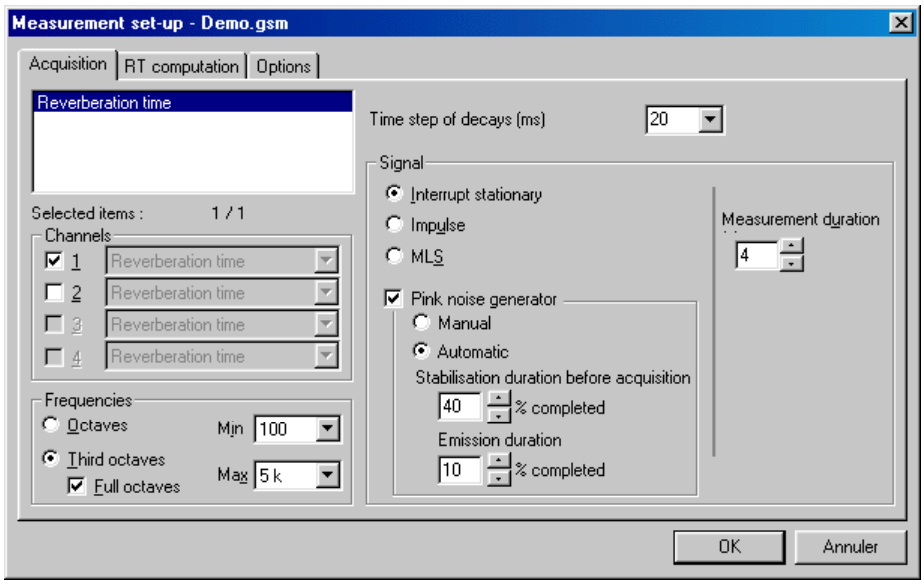
Enable or disable display of the time history plot and select the frequency band to monitor

Enable or disable linked amplitude scales of plots for each active measurement channel

Perform an automatic autoscale to adjust data display at the end of the measurement.

9.2. Measurement set-up

Measurement set-up can be done by pressing the key **Parametrize** of the manager. The dialog box shown below appears on screen :



Refer to chapter 6 for more information on the use of managers.

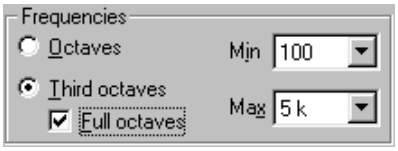
9.2.1. Acquisition channel types for RT measurement

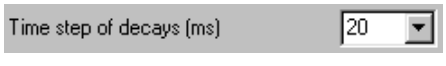
Define the active measurement channels (the acquisition platform input lines) that will be used for spectrum acquisition. Note that only channels that have been enabled in the hardware configuration dialogue box may be selected (see **chapter 4**).

The type « Reverberation time » is automatically associated to each channel (all fields are greyed).

9.2.2. Analysis parameters

Choose between octave and third octave spectrum analysis and define the frequency limits for the analysis.





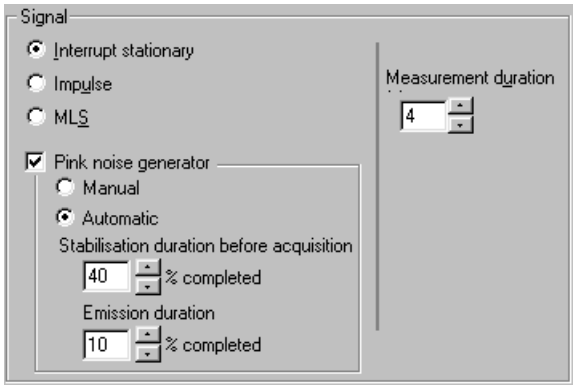
Also, define the time basis used in the computation of the **reverberation time** decay. Greater accuracy is achieved with a smaller time basis, though at the expense of calculation time.

The RT measurement is performed in real-time only if the selected time step is multiple of 20 ms.

9.2.3. Signal characteristics

Select of signal that will be used for the reverberation time measurement.

❑ **Interrupted stationary signal**



dBBATI32 offers reverberation time calculations from a stationary signal (cut-off of a pink noise source).

The duration of the measurement is defined in seconds.

▪ **Noise generator parameters**

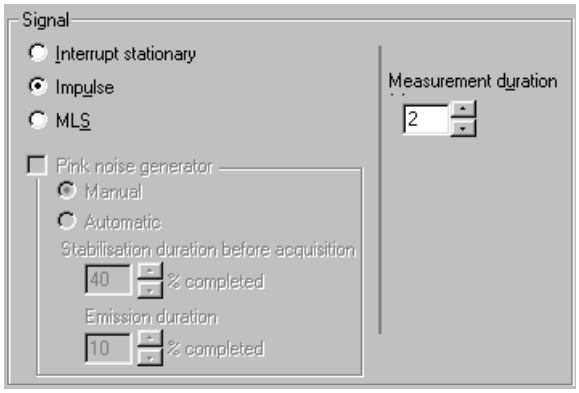
It is necessary to connect an amplified loudspeaker to the LEMO4 output socket of the SYMPHONIE or HARMONIE acquisition box to generate a pink noise.

This generator may manually activated with an icon of the measurement window or the **F11** function key.

It may also be automatically started and stopped by **dBBATI32.** To do so, tick the option **automatic** and define a **stabilisation duration** before staring the acquisition and the **emission duration**, as a function of the percentage of the complete duration of the measurement.

🕮 *Refer to **paragraph 9.4** for detailed explanations on the generator state during a measurement.*

❑ **Impulse signal**



dBBATI32 offers reverberation time calculations from an impulse signal.

The duration of the measurement is defined in seconds.

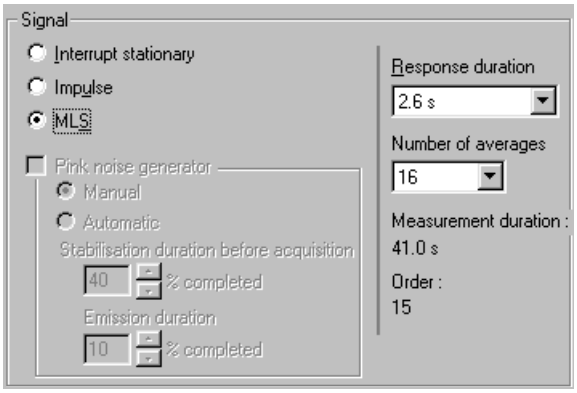
It is recommended to start an acquisition with a threshold trigger (see **paragraph 9.2.6**).

🕮 *Refer to **paragraph 9.4** for detailed explanations on the measurement process.*

❑ MLS signal

In MLS mode (Maximum-Length Sequence), follow the recommendations below.

It is necessary to connect an amplified loudspeaker to the LEMO4 output socket of the SYMPHONIE or HARMONIE acquisition box.



The **response duration** should be carefully selected, as it should be adapted to the geometry of the room.
Make sure that the response duration is long enough in order to obtain a background noise at the end of the measurement.

It is possible to **average** this response in order to decrease the effect of background noise. The higher the average number, the better the response quality, because the influence of random phenomena (background noise) decreases. On the other hand, the acquisition duration increases (the signal to noise ratio increase by 3 dB when doubling the number of averages.

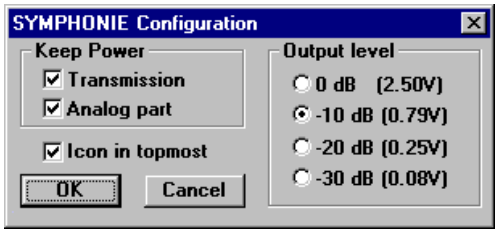
📖 ***Refer to annex 21.2 for more details on the MLS acquisition.*** *Refer to* ***paragraph 9.4*** *for detailed explanations on the measurement process.*

❑ General remark (SYMPHONIE)

The output level of the signal can be set by the SYMPHONIE icon driver from the Windows task bar

Click on the icon

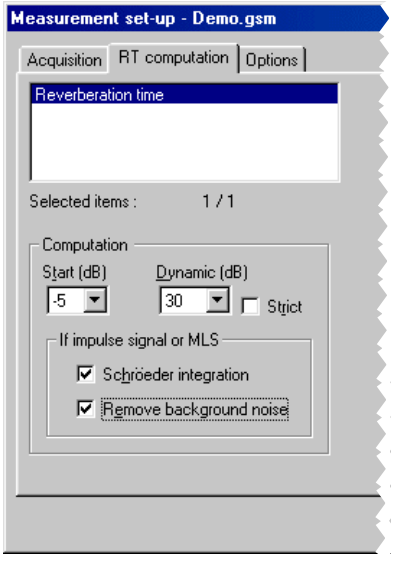
with the right of the mouse. A contextual menu appears. Choose the **Configuration** field and set the SYMPHONIE output level. The output level is changed in real time if you are playing a noise.



📖 *For more information on SYMPHONIE or HARMONIE (for example, connection plugs and driver configuration), consult the system installation manual.*

9.2.4. RT computation parameters

Click on the **Parametrize** key of the measurement manager and select the **RT computation** tab.



dBBATI32 offers reverberation time calculations from either stationary, impulsive or MLS signals.

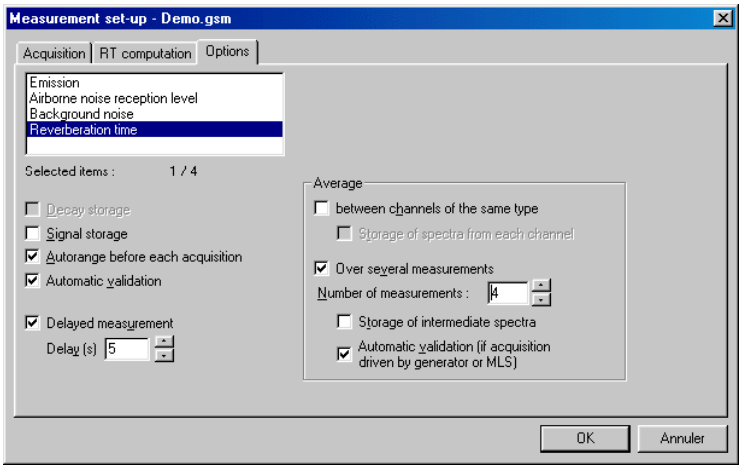
From an impulsive signal source (or MLS signal), it is possible to apply integration (Schröeder) and/or suppress the background noise.

During the calculation phase, the start and end settings define the regression boundaries that are used to calculate the RT values by frequency bands.

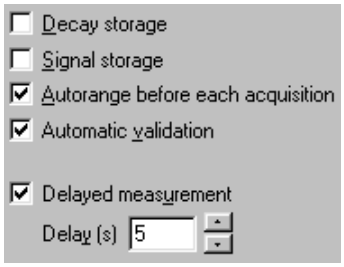
📖 *See* ***chapter 21.2*** *for a detailed reverberation time calculation explanation.*

9.2.5. Measurement options

The configuration of measurement options and (if required) averaging options can be performed in the **Options** tab of the measurement set-up dialog box.



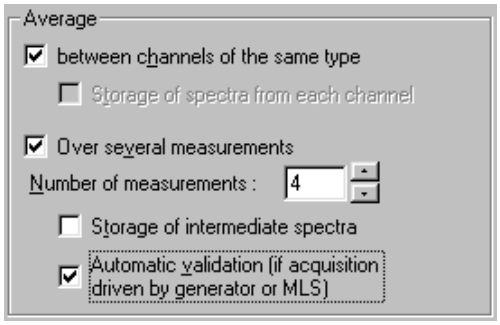
9.2.5.1.Acquisition options



- Define if time **decays** are to be recorded into the measurement session, for later analysis.
- **Define if the audio signal is to be recorded to hard disc.**
  When this option is activated, the audio recording is stored in the active measurement session datafile at the end of the acquisition.
- Perform an **autorange** automatically before each measurement
- **Automatic validation** of the results. Useful when averaging over several measurements.
- Define a **delay** before starting a measurement (so that the operator may leave the room during the measurement process).

📖 *Refer to **paragraph 9.4** for more information on the measurement process.*

9.2.5.2.Averaging options


Average
between channels of the same type
Storage of spectra from each channel
Over several measurements
Number of measurements : 4
Storage of intermediate spectra
Automatic validation (if acquisition driven by generator or MLS)

- **Averaging between channels of the same type**

When a measurement is performed with, say, two active channels, **dBBATI32** calculates the average RT spectra over the two channels. Each spectrum of an active channel may be stored separately.

- **Averaging over several measurements.**

dBBATI32 will calculate a unique averaged spectrum over a sequence of spectra. Use the dialogue box to define the number of measurements to be included in the averaging calculation. Intermediate spectra, calculated for each measurement will be stored in order to effect the averaged spectrum.

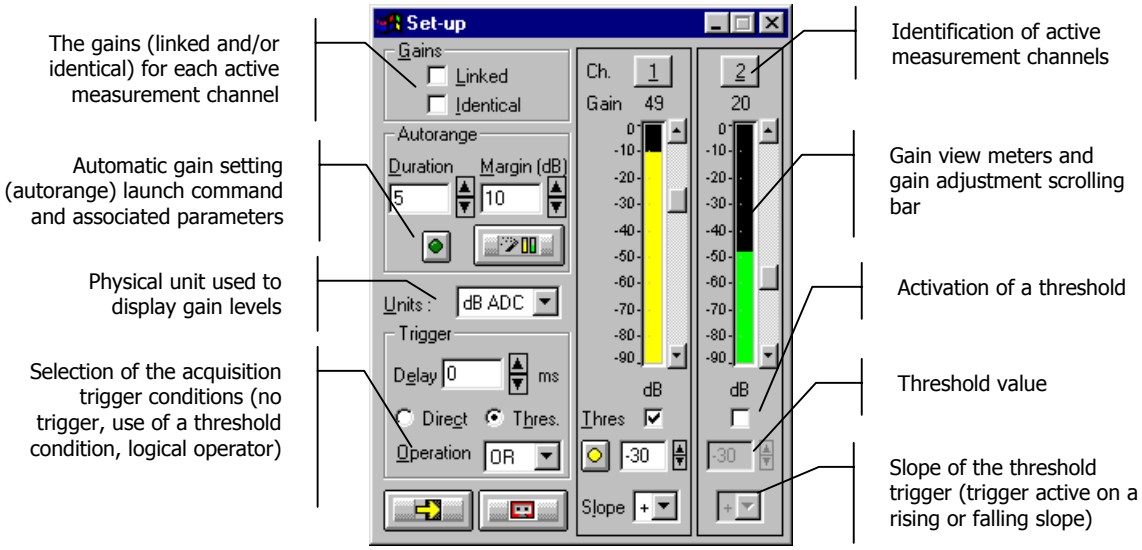
The option **Automatic validation** allows the user to perform a serie of measurements automatically.

📖 *It is possible to combine the two types of averaging methods.*

9.2.6. Gain and threshold command, autorange

Once the measurement set-up has been completed from the measurement manager, perform the following from within the measurement window.

Use the command **Commands / Gains and threshold**. This dialog box enables the definition of gain and threshold settings. These parameters can be used in several ways by the application software. All parameters and the available actions may be enabled or disabled according to the acquisition module, which calls this command.



❑ **Gains**

When the option **Linked** is active, the gains on all active measurement channels are modified: The gain setting of one active channel leads to identical modification on all active measurement channels.

The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

❑ **Autorange** . Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration,** defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

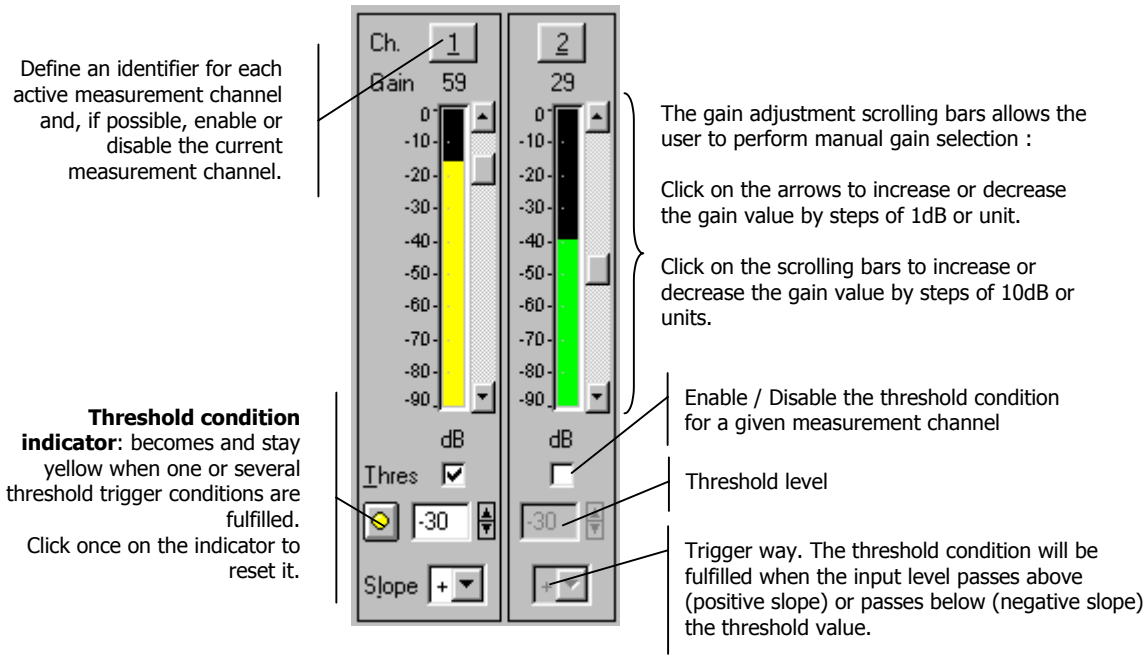
❑ **Units: Selection of the display unit of the input level.** The gain view meters may display the input levels according to three different units:

- **dB Phys**: Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **dB ADC**: Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit**: Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s^2.

❑ **Trigger:** Define here the trigger parameters used for acquisition (not available in MLS mode).

- **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.
- **Trigger delay (in ms)**: For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value
- **Operation**: Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

❑ **Channels**


Define an identifier for each active measurement channel and, if possible, enable or disable the current measurement channel.
Ch. 1
2
Gain 59
29
0 -10 -20 -30 -40 -50 -60 -70 -80 -90
dB
dB
The gain adjustment scrolling bars allows the user to perform manual gain selection :
Click on the arrows to increase or decrease the gain value by steps of 1dB or unit.
Click on the scrolling bars to increase or decrease the gain value by steps of 10dB or units.
Thres
Enable / Disable the threshold condition for a given measurement channel
-30
-30
Threshold level
Threshold condition indicator: becomes and stay yellow when one or several threshold trigger conditions are fulfilled.
Click once on the indicator to reset it.
Slope +
Trigger way. The threshold condition will be fulfilled when the input level passes above (positive slope) or passes below (negative slope) the threshold value.

9.3. Display set-up and status bar

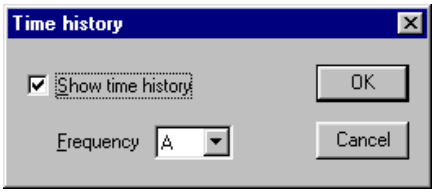
The horizontal toolbar can be used to set the graphical display parameters of the measurement window.

9.3.1. Dynamic settings

Use the command **Display / Autoscale** to automatically re-scale the plots as a function of the measured noise levels.

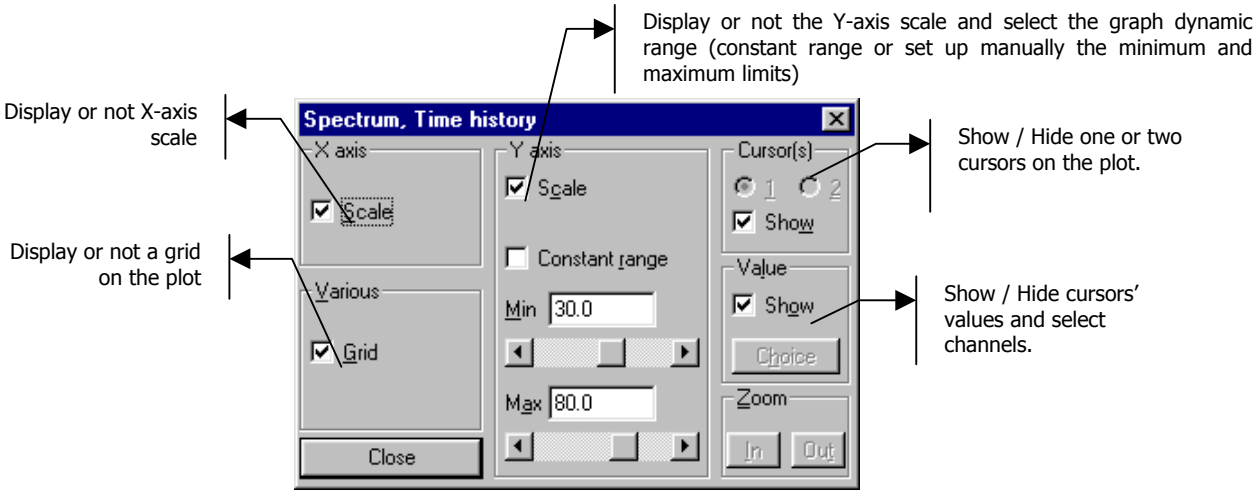
Use the command **Display / Link channels** to enable or disable linked amplitude scales of plots for each active measurement channel..

Use the command **Display / Automatic autoscale at the end of acquisition** to automatically re-scale the plots at the end of the acquisition process



Use the command **Display / Time history** to display the time history plot and select the frequency band to monitor. The following dialog box appears on-screen.
Tick the box **Show time history** and select the **frequency** band (or overall level) to display.

Use the command **Display / Set-up** to define the display parameters of each type of data (spectra and time histories) in the measurement window. The following dialog box is displayed on screen.

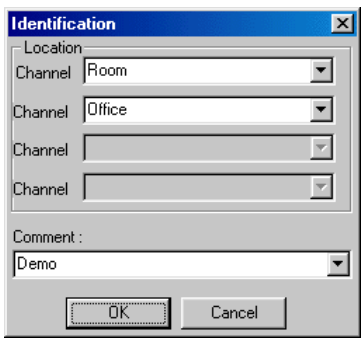


9.3.2. Status bar

The status bar allows the operator to select the measurement locations and input a general comment, either by direct input or by selection in a list, corresponding to the last 4 locations completed by the operators and the default locations.

It is possible to edit different locations for each measurement channels by using the syntax Location1 / Location2 in the edit zone. For example, the syntax Room / Office will affect the location Room to channel 1 and Office to channel 2.

This operation may be done with the command **Commands / Identifier**. The dialog shown aside is displayed on screen. Input the locations for each active channels and a general comment.



9.4. Measurement process

9.4.1. Procedure

After measurement configuration, the user can control the measurement process with the following icons:

Start the acquisition process (F3)
The acquisition starts according to the defined acquisition and averaging parameters. When a trigger condition is defined (with the command Gain and threshold), the analyser waits for the trigger event, in order to start the measurement.

Stop an acquisition in progress (F4)

Accept current results (F7)
The measurement results are saved in a measurement session datafile.

Do not accept current results and restart the measurement (F6)

Time decay edition (See **chapter 10**). Display the time decay adjustment window to adjust manually the decay 'slope in each frequency band, if the RT measurement results are not correct
.

Start / Stop the pink noise generator (F11)
It is possible to generate a pink noise in order to carry out RT measurements with source cut-off (interrupted stationary signal). **See paragraph 9.2.3** on the configuration of the generator. The first press on this icon activates the generator while the second one stops it.
It is recommended to set the gain values of the acquisition platform while the generator is switched on in order to avoid overloads

The following icons are displayed if averaging conditions are defined (see **paragraph 9.2.5.2**).

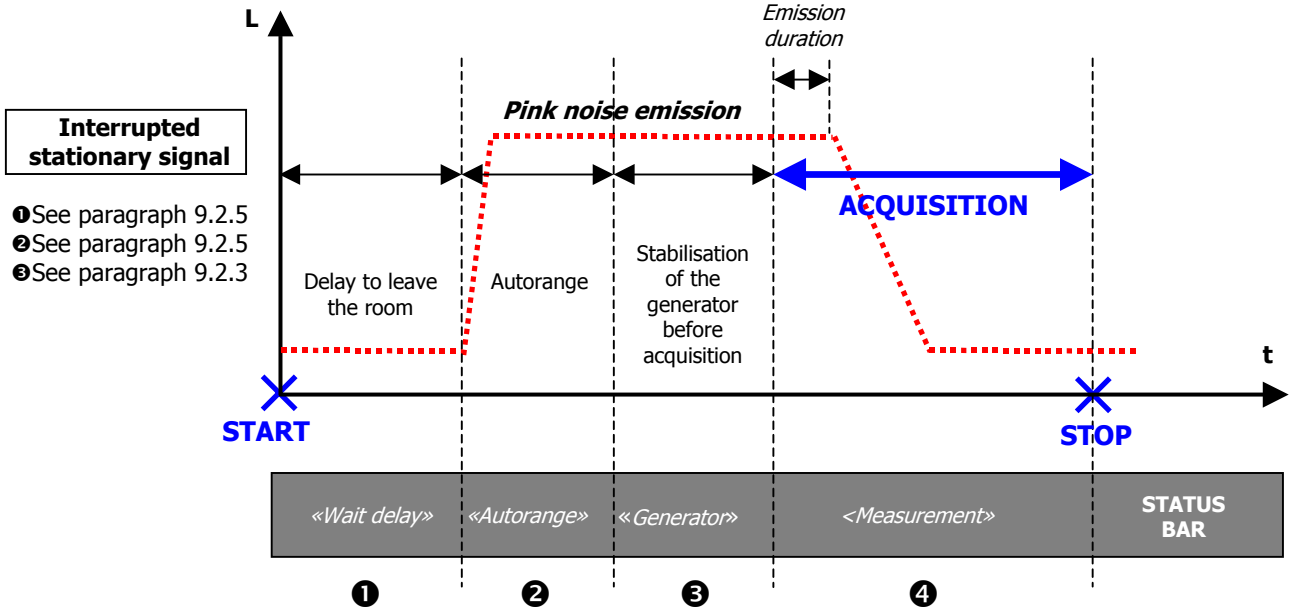
Store the current averaged RT spectra in a measurement session datafile

Reset the current averaged spectra

Save results in a measurement session datafile

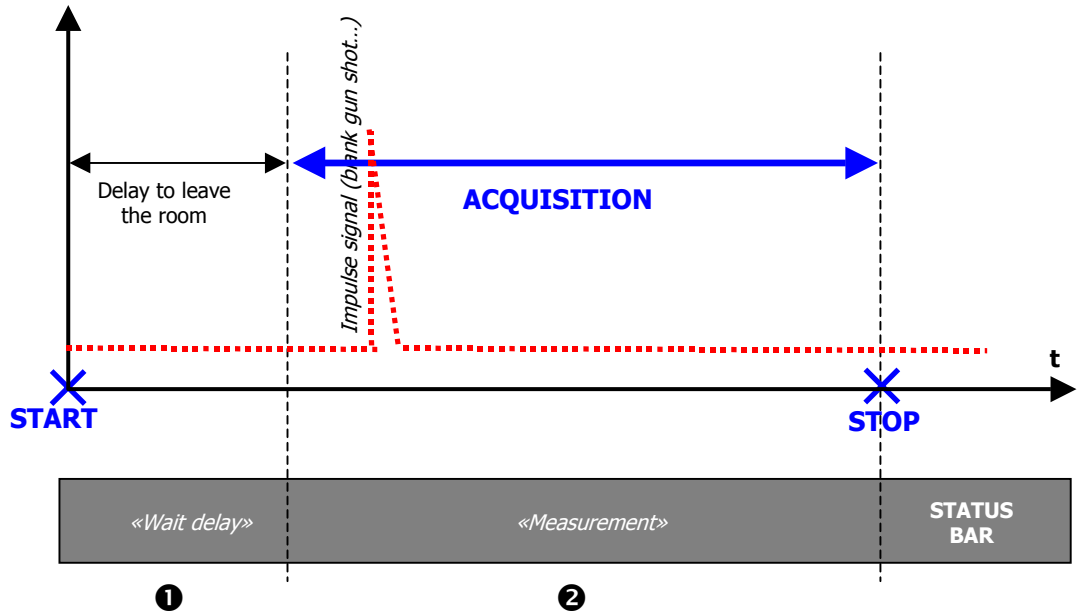
9.4.2. Sketches

The following sketch summarises the RT measurement process for the 3 modes available in **dBBATI32**. the states of the generator and the status bar at the different stages of the acquisition process are indicated.



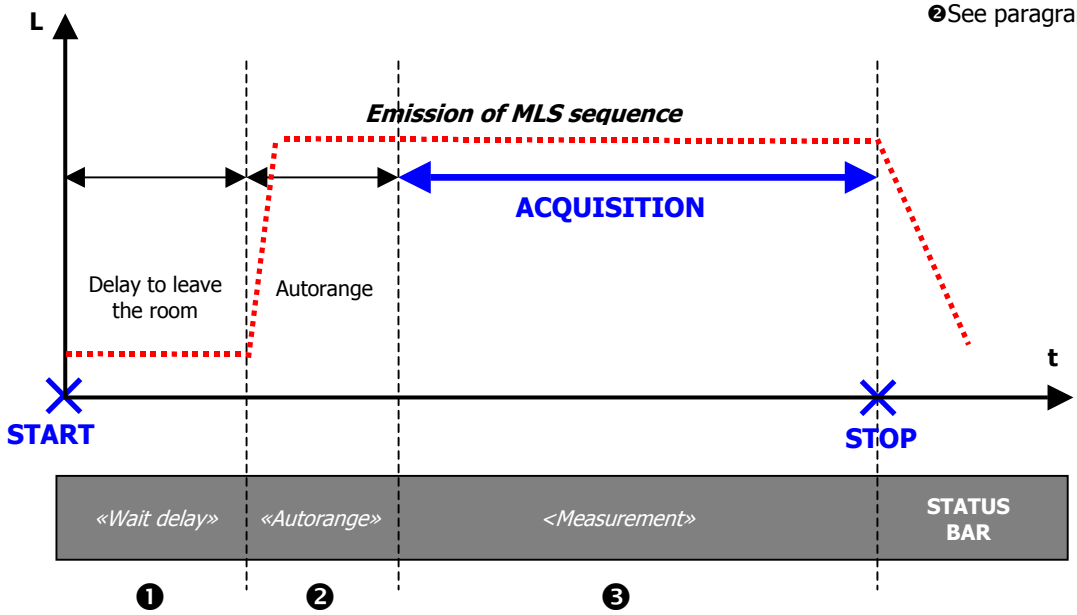
Impulse signal

❶See paragraph 9.2.5



MLS Signal

❶See paragraph 9.2.5
❷See paragraph 9.2.5

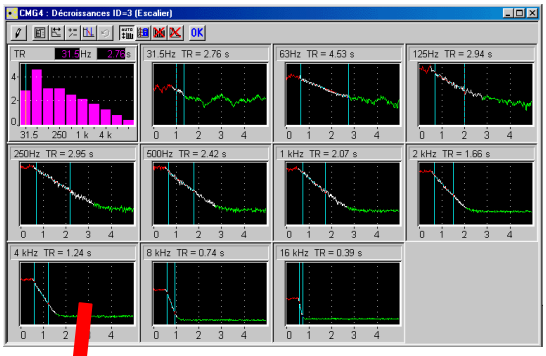


The states Wait delay, Autorange and Stabilisation of the generator are optional.

10. DECAY EDITION WINDOW (RT)

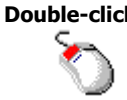
The time decay edition window is used to display **the time decays that are used to compute a reverberation time spectrum**.

This window is displayed at the end of the RT measurement or analysis process (see **chapters 9 and 17**).
It is also possible to modify time decays linked to an existing RT spectrum of the measurement session.
When editing a time decay item, it is not possible to close the measurement session.



This window is made up of A frame showing the current RT spectrum resulting from regression calculation of the time decay of each frequency band and the time decays of each frequency band. The slope of these decays (on which the RT value depends) can be adjusted manually.

It is possible to zoom each time decay frame by double clicking within its frame (or by pressing the **Enter** key)



These elements are automatically selected according to the user defined RT calculation parameters and the calculation algorithm. The toolbar of this window allows the user to perform the following operations:

- Modify the measurement identifier and add comments
- Define or modify the calculation parameters
- Define a study zone for a given frequency band. dBBATI32 allows the user to exclude any part of the time history such as noise, parasites, double decay etc, that are not useful for the calculation process.
- Relaunch an automatic RT spectrum calculation according to the current RT calculation parameters.
- Enable or disable the decay manual adjustment mode. When enabled, this option allows the user to select the start and end points of the regression calculations. Simply select these points with the cursors on the adequate decay plot.
- Undo the latest slope adjustment
- Automatic re-scaling of the plots
- Link cursors on all the graphical view (not active for RT adjustment)
- Hide display of the RT spectrum
- Hide display of the time histories
- Save the results in the active measurement session
- Close the time decay edition window without saving

11. ROOM CRITERIA MEASUREMENTS

dBBATI32 allows the user to compute the following room criteria :

- **Quality criteria :** RT, EDT, Clarity, Definition, ST1.
- **Intelligibility criteria :** STI, RASTI.

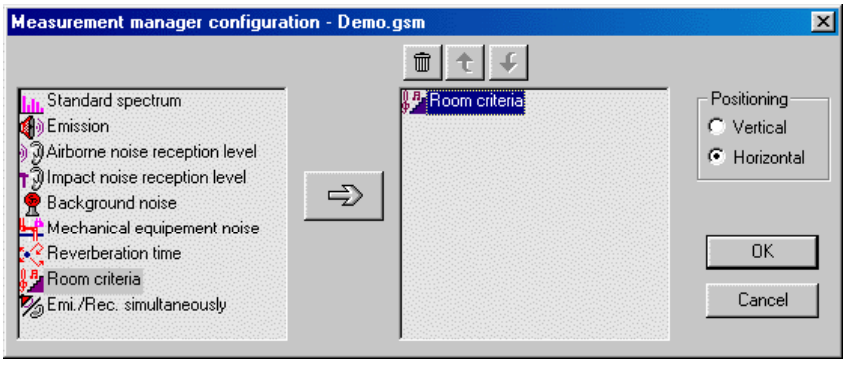
These criteria are obtained from echogram curves per frequency bands. These curves result from an analysis by digital filtering from an impulse response of the room. This response may be obtained by MLS technique.

📖 *Refer to **chapter 21.5** for detailed explanations on the calculations, criteria definition and results' interpretation.*

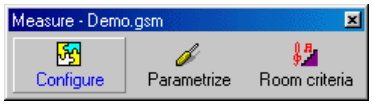
This chapter deals the measurement set-up and process of room criteria in **dBBATI32**.

Use the command **Acquisition / New** to pen a new measurement manager. This manager is used to select which measurement will be performed and to configure the acquisition parameters of each one of them.

Click on **Configure** to select which elements will be added to the manager. In this chapter, we select the type of elements **room criteria**.



The manager toolbar then looks like this:



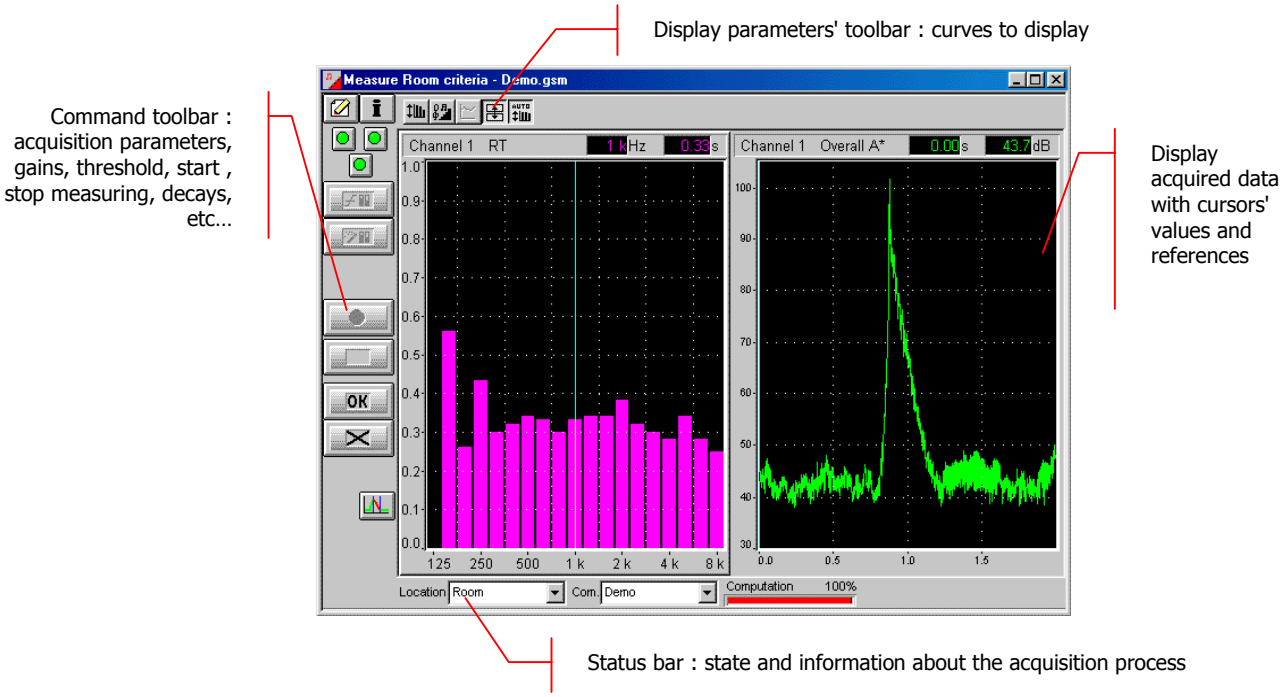
📖 *Refer to **chapter 6** for more information on how to use the managers in **dBBATI32**.*

All the display and acquisition parameters can be saved in a measurement manager file (*.GSM) by using the command **Acquisition / Save As**.

11.1. Measurement window overview

The measurement window can be accessed by the icon

room criteria of the manager toolbar.


Display parameters' toolbar : curves to display
Command toolbar : acquisition parameters, gains, threshold, start , stop measuring, decays, etc…
Display acquired data with cursors' values and references
Measure Room criteria - Demo.gsm
Channel 1 RT
Channel 1 Overall A*
OK
Location Room
Com. Demo
Computation 100%
Status bar : state and information about the acquisition process

The measurement configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

Definition of the measurement identifier (location and comment)

Show/hide information table

Overloads and threshold exceedance display.

The upper part shows overload LEDs (instantaneous on the left, max hold on the right).
The lower part shows a threshold exceedance LED (see **paragraph 11.2.6**).

Reset LEDs indication by a simple click on it

Define gain and threshold parameters

Perform an automatic gain adjustment (autorange)

Start the acquisition process

Stop the acquisition in progress

Validate current results and store them in a measurement session datafile

Cancel current results and start again

Display the time decay edition window to adjust values (See **chapter 12**).

The display type and the display parameters of the active curves are controlled using the **horizontal toolbar**:

Automatic re-scaling of the spectra and time history plots

Select the room criterion to display in the spectrum view.

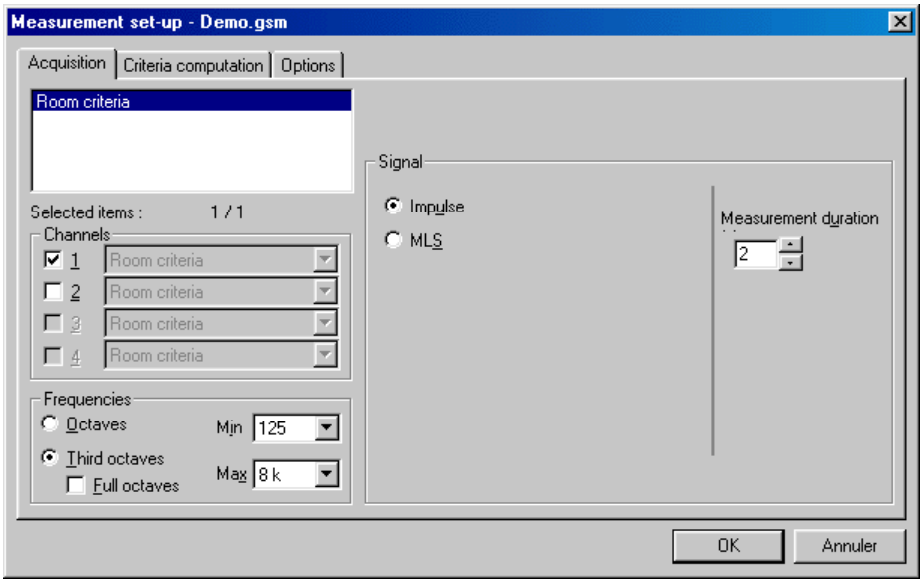
Enable or disable display of the time history plot and select the frequency band to monitor

Enable or disable linked amplitude scales of plots for each active measurement channel

Perform an automatic autoscale to adjust data display at the end of the measurement.

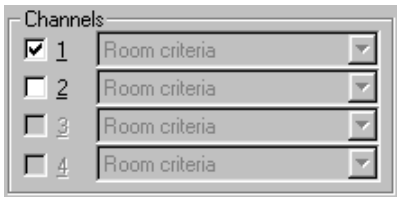
11.2. Measurement set-up

Measurement set-up can be done by pressing the key **Parametrize** of the manager. The dialog box shown below appears on screen :



Refer to chapter 6 for more information on the use of managers.

11.2.1.Acquisition channel types for room criteria measurement

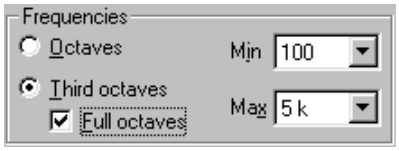


Define the active measurement channels (the acquisition platform input lines) that will be used for spectrum acquisition. Note that only channels that have been enabled in the hardware configuration dialogue box may be selected (see **chapter 4**).

The type « Room criteria » is automatically associated to each channel (all fields are greyed).

11.2.2.Analysis parameters

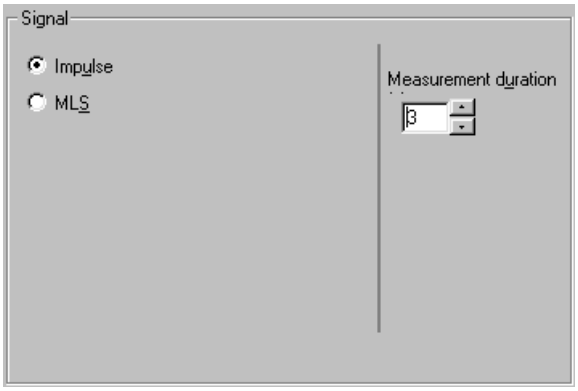
Choose between octave and third octave spectrum analysis and define the frequency limits for the analysis.



11.2.3.Signal characteristics

Select of signal that will be used for the room criteria measurement.

❑ Impulse signal



dBBATI32 offers room criteria computation from the measurement of an impulse response.

The duration of the measurement is defined in seconds.

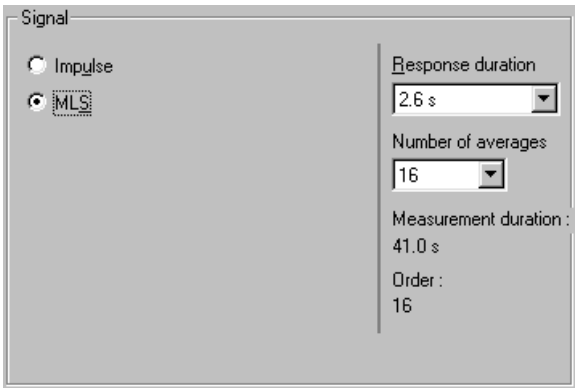
📖 *Refer to **paragraph 21.5** for the calculation principle of room criteria.*

📖 *Refer to **paragraph 11.4** for detailed explanations on the measurement process.*

❑ MLS Signal

In MLS mode (Maximum-Length Sequence), follow the recommendations below.

It is necessary to connect an amplified loudspeaker to the LEMO4 output socket of the SYMPHONIE or HARMONIE acquisition box.



The **response duration** should be carefully selected, as it should be adapted to the geometry of the room.
Make sure that the response duration is long enough in order to obtain a background noise at the end of the measurement.

It is possible to **average** this response in order to decrease the effect of background noise. The higher the average number, the better the response quality, because the influence of random phenomena (background noise) decreases. On the other hand, the acquisition duration increases (the signal to noise ratio increase by 3 dB when doubling the number of averages.

📖 ***Refer to annex 21.2 for more details on the MLS acquisition.***

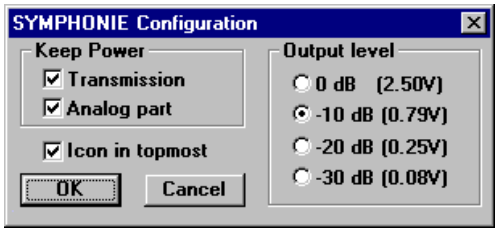
📖 *Refer to **paragraph 21.5** for the calculation principle of room criteria. Refer to **paragraph 11.4** for detailed explanations on the measurement process.*

❑ General remark (SYMPHONIE)

The output level of the signal can be set by the SYMPHONIE icon driver from the Windows task bar

Click on the icon

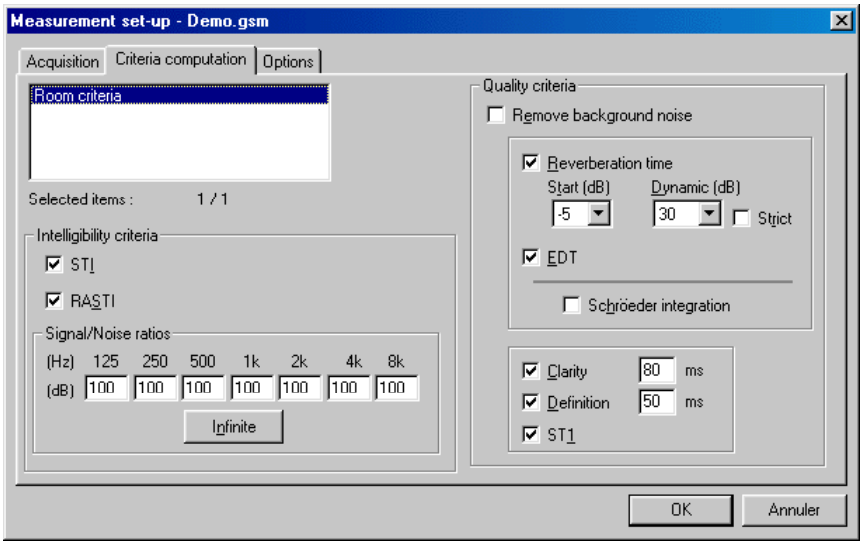
with the right of the mouse. A contextual menu appears. Choose the **Configuration** field and set the SYMPHONIE output level. The output level is changed in real time if you are playing a noise.



📖 *For more information on SYMPHONIE or HARMONIE (for example, connection plugs and driver configuration), consult the system installation manual..*

11.2.4.Criteria computation parameters

Click on the **Parametrize** key of the measurement manager and select the **criteria computation** tab**.** This dialog box is used to select the criteria that will be computed from the measured impulse response.



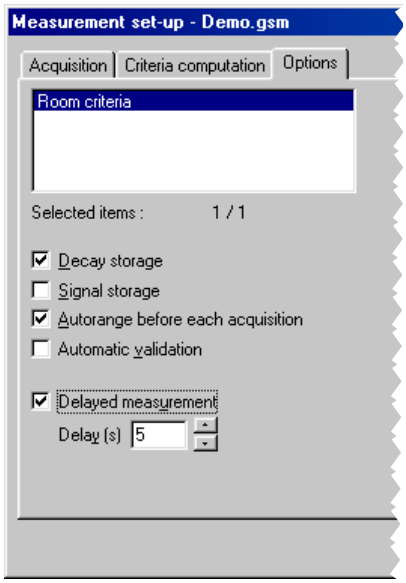
📖 *Refer to **paragraph 21.5** for the calculation principle and definition of room criteria*

The computation of intelligibility criteria account for the signal to noise ratios per frequency bands. It is however to manually inputs these values.

By default, background noise is considered neglectable, thus having a signal to noise ratio infinite (100).

11.2.5.Measurement options

The configuration of measurement options can be performed in the **Options** tab of the measurement set-up dialog box.



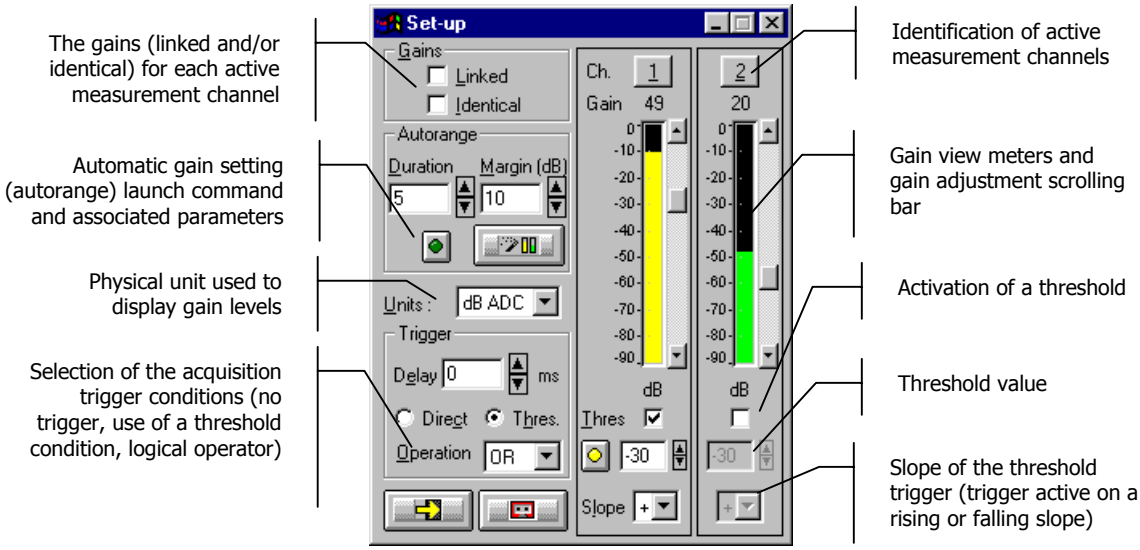
- Define if **decays** are to be recorded into the measurement session, for later analysis.
- **Define if the audio signal is to be recorded to hard disc.** When this option is activated, the audio recording is stored in the active measurement session datafile at the end of the acquisition.
- Perform an **autorange** automatically before each measurement
- **Automatic validation** of the results.
- Define a delay before starting a measurement (so that the operator may leave the room during the measurement process).

📖 *Refer to **paragraph 11.4** for more information on the measurement process.*

11.2.6.Gain and threshold command, autorange

Once the measurement set-up has been completed from the measurement manager, perform the following from within the measurement window.

Use the command **Commands / Gains and threshold**. This dialog box enables the definition of gain and threshold settings. These parameters can be used in several ways by the application software. All parameters and the available actions may be enabled or disabled according to the acquisition module, which calls this command.



❑ **Gains**

When the option **Linked** is active, the gains on all active measurement channels are modified: The gain setting of one active channel leads to identical modification on all active measurement channels.

The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

❑ **Autorange** . Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration,** defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

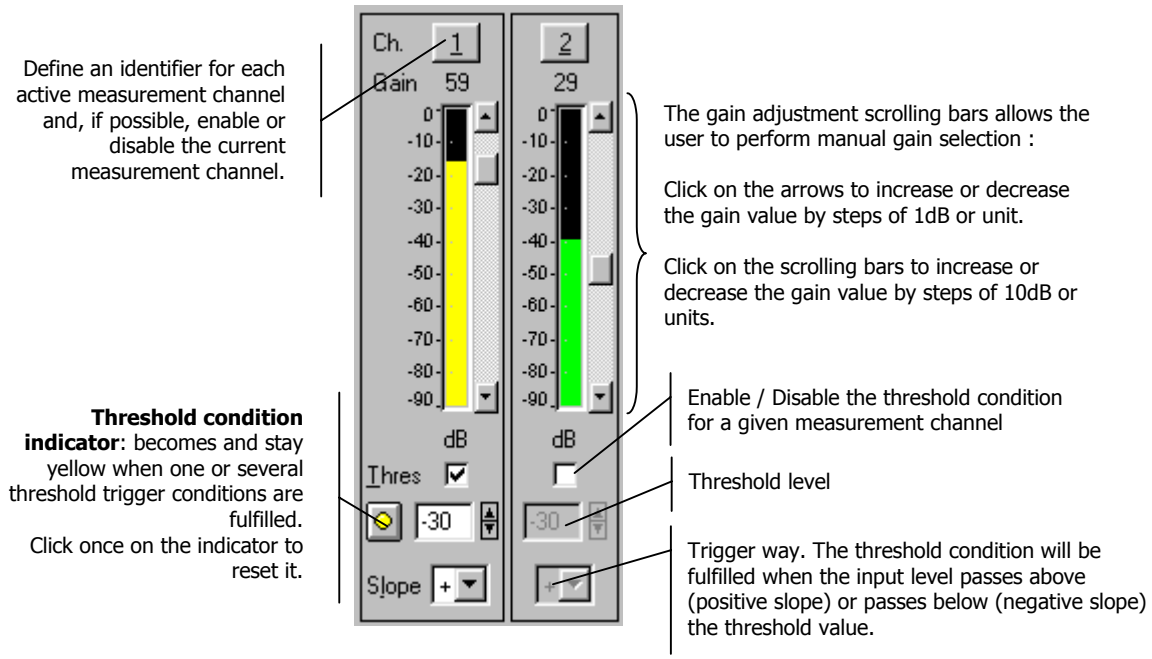
❑ **Units: Selection of the display unit of the input level.** The gain view meters may display the input levels according to three different units:

- **dB Phys**: Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **dB ADC**: Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit**: Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s^2.

❑ **Trigger:** Define here the trigger parameters used for acquisition (not available in MLS mode).

- **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.
- **Trigger delay (in ms)**: For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value
- **Operation**: Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

❑ **Channels**


Define an identifier for each active measurement channel and, if possible, enable or disable the current measurement channel.
Ch.
1
2
Gain
59
29
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
dB
dB
The gain adjustment scrolling bars allows the user to perform manual gain selection :
Click on the arrows to increase or decrease the gain value by steps of 1dB or unit.
Click on the scrolling bars to increase or decrease the gain value by steps of 10dB or units.
Thres
Enable / Disable the threshold condition for a given measurement channel
-30
-30
Threshold level
Threshold condition indicator: becomes and stay yellow when one or several threshold trigger conditions are fulfilled.
Click once on the indicator to reset it.
Slope
+
Trigger way. The threshold condition will be fulfilled when the input level passes above (positive slope) or passes below (negative slope) the threshold value.

11.3. Display set-up and status bar

The horizontal toolbar can be used to set the graphical display parameters of the measurement window.

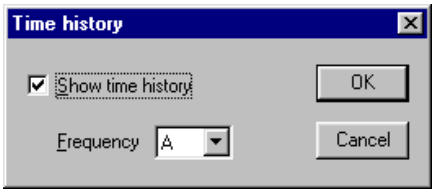
11.3.1.Dynamic settings

Use the command **Display / Autoscale** to automatically re-scale the plots as a function of the measured noise levels.

Use the command **Display / Criteria...** to select the criterion that will be displayed on the spectrum view. Only the criteria selected during measurement set-up may be displayed..

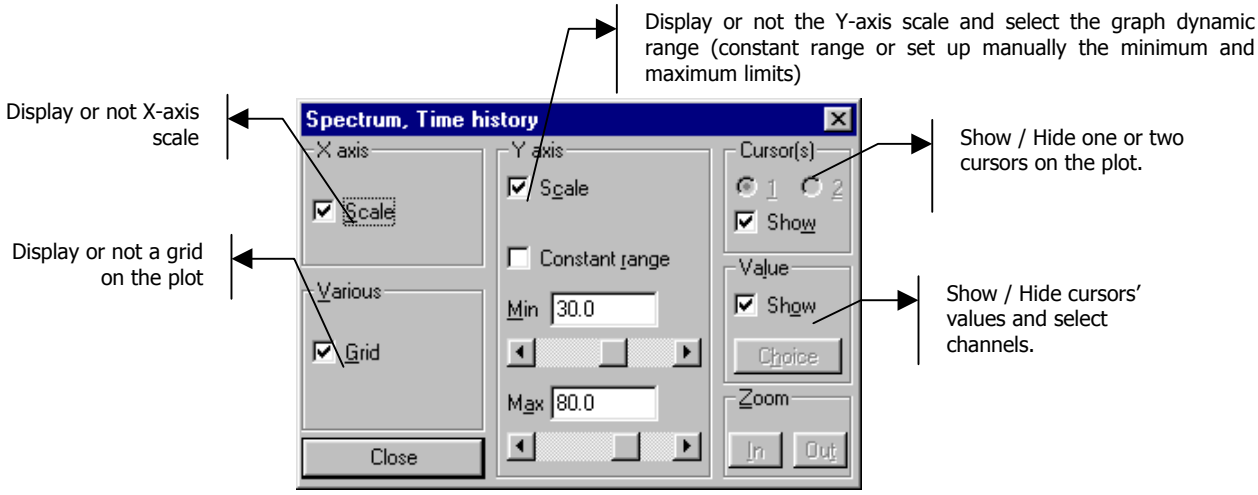
Use the command **Display / Link channels** to enable or disable linked amplitude scales of plots for each active measurement channel..

Use the command **Display / Automatic autoscale at the end of acquisition** to automatically re-scale the plots at the end of the acquisition process



Use the command **Display / Time history** to display the time history plot and select the frequency band to monitor. The following dialog box appears on-screen.
Tick the box **Show time history** and select the **frequency** band (or overall level) to display.

Use the command **Display / Set-up** to define the display parameters of each type of data (spectra and time histories) in the measurement window. The following dialog box is displayed on screen.

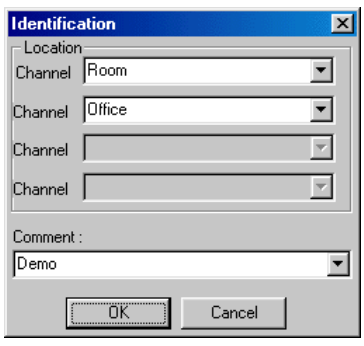


11.3.2.Status bar

The status bar allows the operator to select the measurement locations and input a general comment, either by direct input or by selection in a list, corresponding to the last 4 locations completed by the operators and the default locations.

It is possible to edit different locations for each measurement channels by using the syntax Location1 / Location2 in the edit zone. For example, the syntax Room / Office will affect the location Room to channel 1 and Office to channel 2.

This operation may be done with the command **Commands / Identifier**. The dialog shown aside is displayed on screen. Input the locations for each active channels and a general comment..



11.4. Measurement process

11.4.1.Procedure

After measurement configuration, the user can control the measurement process with the following icons:

Start the acquisition process (F3)
The acquisition starts according to the defined acquisition and averaging parameters. When a trigger condition is defined (with the command Gain and threshold), the analyser waits for the trigger event, in order to start the measurement.

Stop an acquisition in progress (F4)

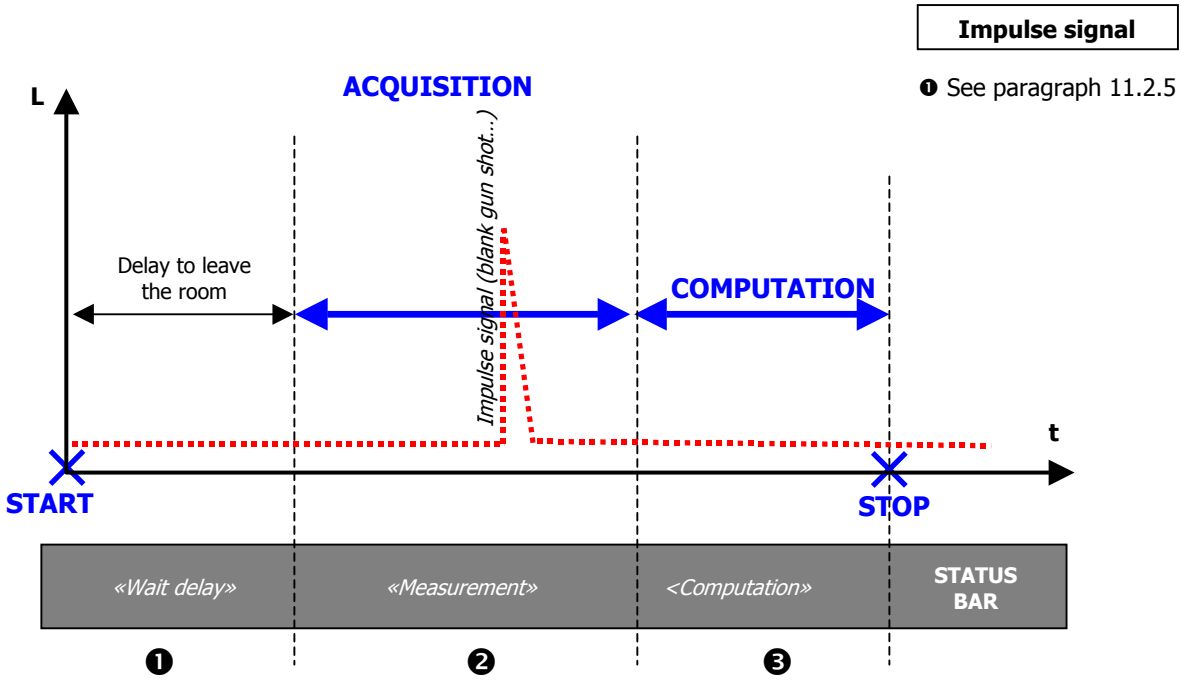
Accept current results (F7)
The measurement results are saved in a measurement session datafile.

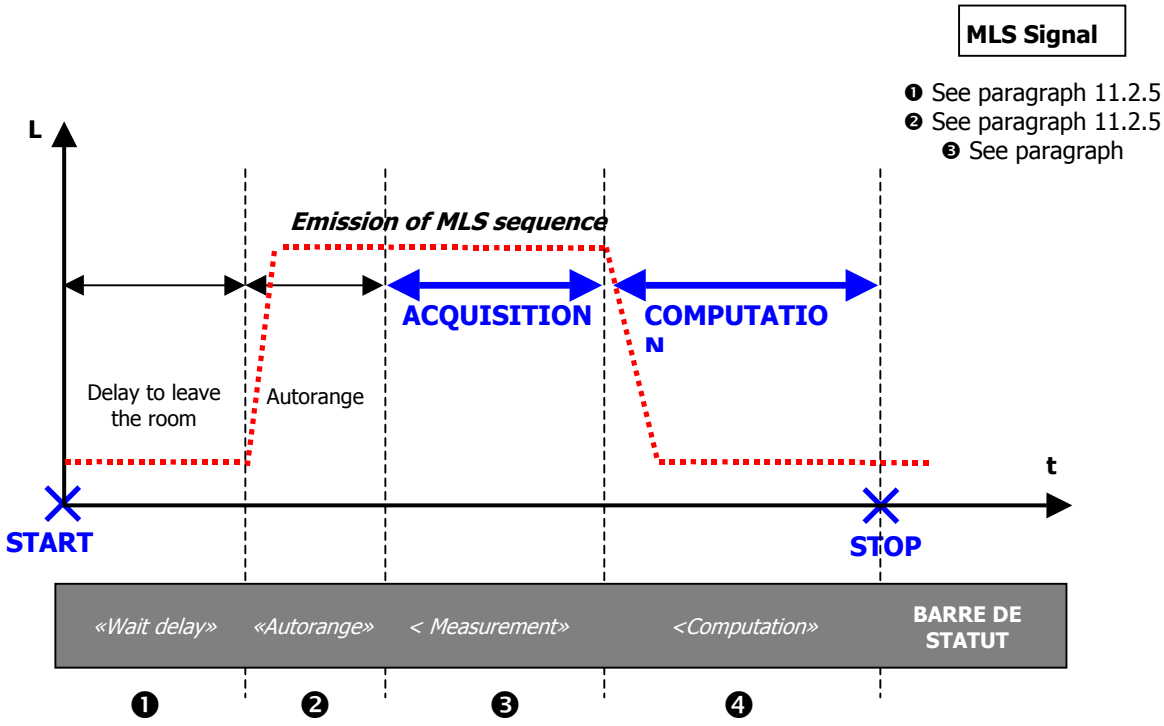
Do not accept current results and restart the measurement (F6)

Decay edition (See **chapter 12**). Display the decay adjustment window to adjust manually the decay 'slope and direct wave arrival in each frequency band, if the measurement results are not correct

11.4.2.Sketches

The following sketch summarises the room criteria measurement process for the 3 modes available in **dBBATI32**. the states of the generator and the status bar at the different stages of the acquisition process are indicated.





The states Wait delay and Autorange are optional.

12. DECAY EDITION WINDOW (ROOM CRITERIA)

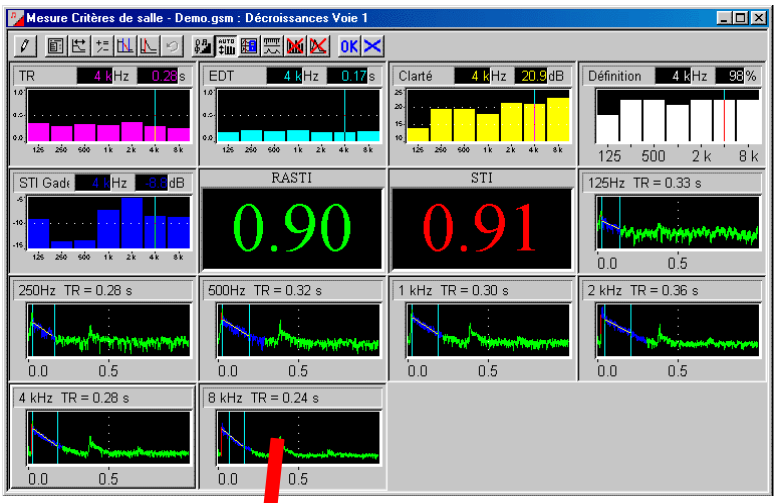
The time decay edition window is used to display **the decays that are used to compute room criteria**. This window is displayed at the end of the room criteria measurement or analysis process (see **chapters 11 and 18**).

It is also possible to modify decays linked to an existing RT spectrum of the measurement session. *When editing a decay item, it is not possible to close the measurement session*

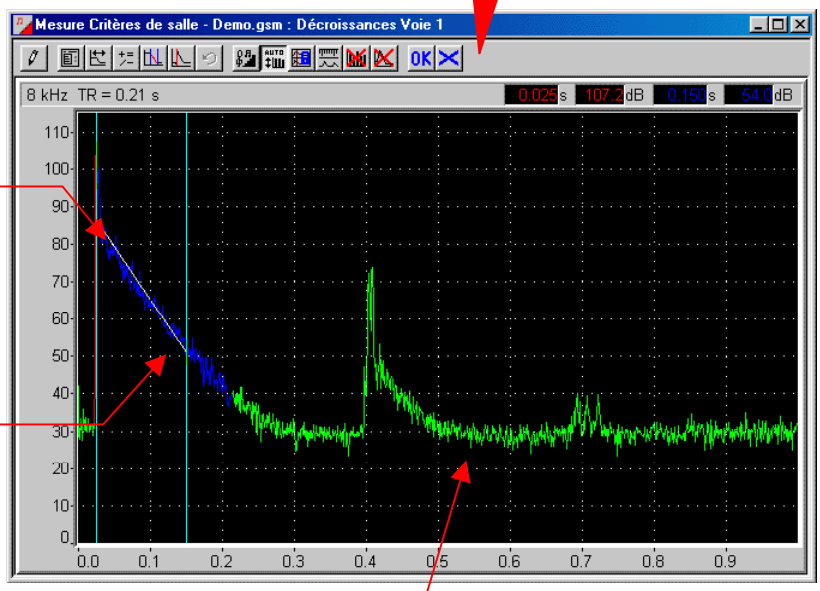
This window present :

- The spectra or values of the room criteria
- The time decays for each active frequency band

It is possible to zoom each time decay frame by double clicking within its frame (or by pressing the Enter key)



Double-click


Mesure Critères de salle - Demo.gsm : Décroissances Voie 1
8 kHz TR = 0.21 s
Regression line computed. The slope represents the RT value in seconds
Active decay used for regression computation
Background noise level

The search for the arrival of the direct wave and the decay zone is performed automatically by applying a calculation algorithm for room criteria.

If the signal being studied is not clean, the algorithm for searching the decay zones cannot be applied. It is therefore required to manually adjust the arrival of the direct wave, and maybe the RT calculation limit (see example below).

The toolbar of this window allows the user to perform the following operations:

Modify the measurement identifier and add comments

Define or modify the calculation parameters

Define a study zone for a given frequency band. dBBATI32 allows the user to exclude any part of the time history such as noise, parasites, double decay etc, that are not useful for the calculation process.

Relaunch an automatic criteria calculation according to the current calculation parameters.

Enable or disable the decay manual adjustment mode. When enabled, this option allows the user to select the start and end points of the regression calculations.

Activate manual adjustment of the beginning point of the direct wave

Undo the latest slope or direct wave adjustment

Select the room criteria to display

Automatic re-scaling of the plots

Link cursors on all the graphical view (not active for RT adjustment)

Activate labelling of decay X-axis in distances rather then time

Hide display of the results

Hide display of the time histories

Save the results in the active measurement session

Close the time decay edition window without saving

Example : Manual adjustment of the direct wave

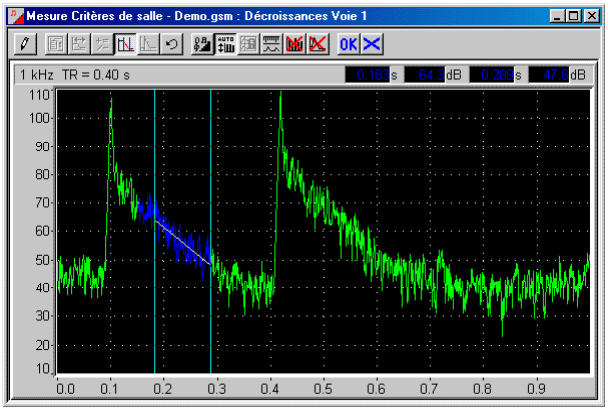
In this example, the impulse response features 2 successive peaks.
dBBATI32 cannot therefore correctly apply the room criteria calculation algorithm.

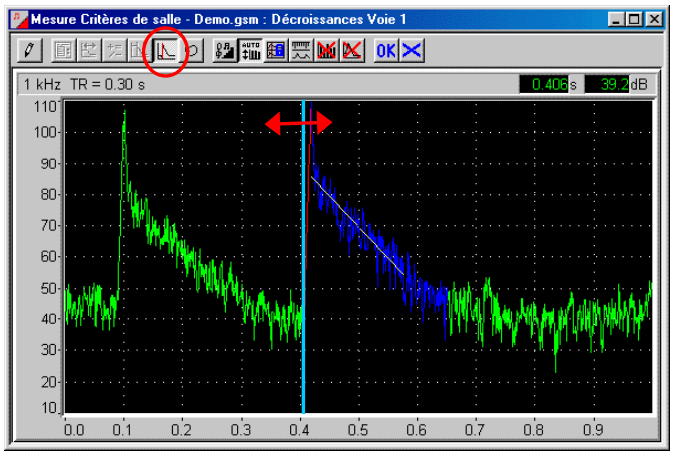
Let consider that the first peak is a parasite noise. Room criteria calculation must be applied to the second decay.

Use the function for **adjusting the direct wave** and move the cursor to the start of the second peak.

dBBATI32 then apply automatically the decay search algorithm and indicate by a different colour the new study zone.

The regression line used to compute the RT spectrum is also re-calculated.





Advice

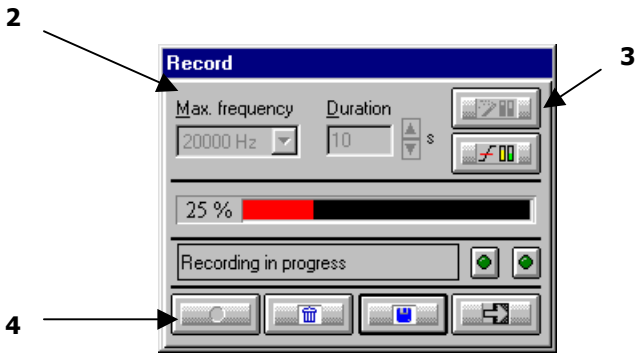
Use the linked cursors' command to adjust the direct wave start for all frequency bands.

13. SIGNAL ACQUISITION

This command is accessible from the menu **Acquisition / Record**. The user can record audio signals then perform any type of off-line processing operation. This command can be used as a digital tape recorder (DAT).
The analysis manager may be used to analyse audio recordings as **spectra (chapter 16)**, **reverberation time spectra** (**chapter 17**) or **room criteria** (**chapter 18**).

13.1. Recording command

The **Record** dialogue box allows the user to define the recording parameters and to carry out an acquisition.



With the following buttons the user can configure and control recordings:

Start an automatic gain setting (autorange)

Show gain view meter and set the gains and threshold parameters

Start recording

Stop the acquisition without saving signal file

Stop recording and save signal file before the end of measurement duration

Exit the signal recording mode

After configuration (see **chapter 4**) and calibration (see **chapter 5**) of the measurement chain, the user can follow this procedure to carry out signal recordings:

❑ **Stage 1 : Definition of the acquisition mode (see paragraph 13.3)**

Select the menu **Acquisition** / **Record configuration** and the rearming mode: manual or automatic (using a threshold trigger). Then choose the command **Acquisition / Record**

❑ **Stage 2: Setting up the measurement parameters**

Define the following parameters:

- **The acquisition frequency range**

Choose the frequency range for the acquisition. This range defines the sampling frequency of the signal file. The relation between the sampling frequency and the pass band is defined by the Shannon theorem.

The list of available frequency ranges depends on the hardware platform.

Symphonie, Harmonie : 20 000 Hz, 10 000 Hz, 5 000 Hz, 2 500 Hz, 1 250 Hz, 625 Hz, 300 Hz, 150 Hz, 80 Hz, 40 Hz.
Jazz : 20 000 Hz, 10 000 Hz, 5 000 Hz, 1 000 Hz, 500 Hz, 100 Hz, 50 Hz.

- **The maximum record duration.**

Define the duration for audio recording. Use the arrows up/down to increase/reduce the duration of audio recording or input directly the recording duration via keyboard.
The maximum recording duration depends on the available hard disk space and the chosen pass band.

❑ **Stage 3 : Threshold and gain settings** **/ Autorange** **(see paragraph 13.2)**

Select the icon of manual or automatic gain setting (autorange).

These commands are useful to set up the measurement dynamic range, in order to avoid overloads and underloads during recording. The autorange is useful, if the sound level does not vary greatly over the recording duration.

The thresholds allow to start a measurement automatically, if a sound level passes under (or over) the defined threshold.

The user can check with the overload indicators, if a threshold is exceeded (the lamp on the left-hand side becomes yellow, if a threshold is exceeded) or if an overload has occurred (the lamp on the right hand side becomes red in case of overload).

❑ **Stage 4 : Audio signal recording**

Start recording after configuring the parameters. The recordings are saved on the hard disk of the computer in a measurement session file (*.CMG). Use the following commands:

Start recording according to the defined parameters (by using a trigger condition, the acquisition starts only if this one is fulfilled).

Stop recording without saving the audio event.

Stop recording and save signal file before the end of measurement duration.

Exit the signal-recording mode

An indicator of the dialogue box reflects the recording status:

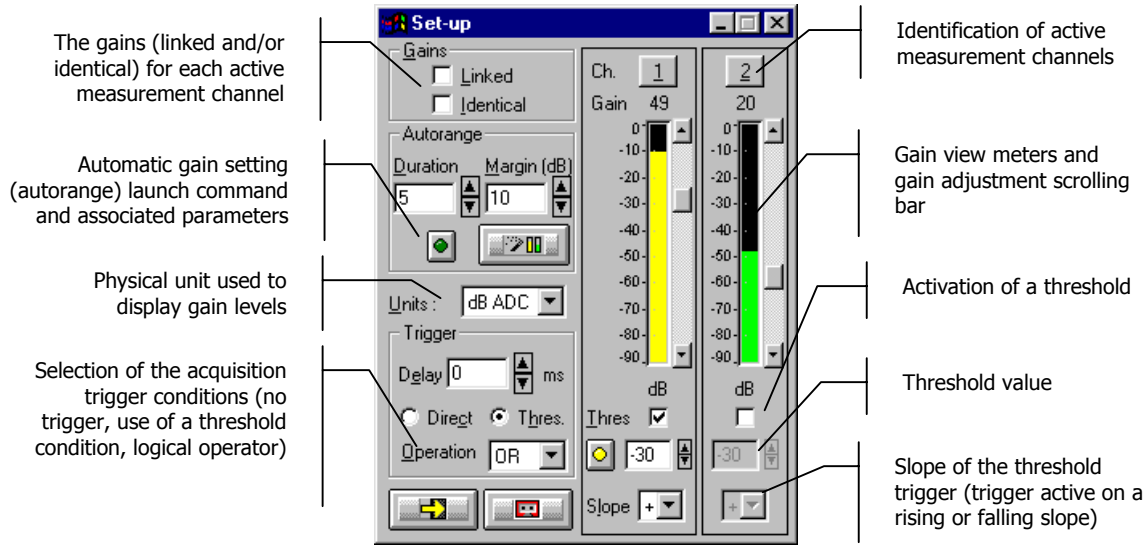
The programme waits for acquisition start command.

The recording is activated, but the trigger condition has to be fulfilled for signal recording.

A recording is in progress.

13.2. Gain and threshold command

This dialog box enables the definition of gain and threshold settings. These parameters can be used in several ways by the application software. All parameters and the available actions may be enabled or disabled according to the acquisition module, which calls this command.



❑ **Gains**

When the option **Linked** is active, the gains on all active measurement channels are modified: The gain setting of one active channel leads to identical modification on all active measurement channels.

The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

❑ **Autorange** . Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration,** defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

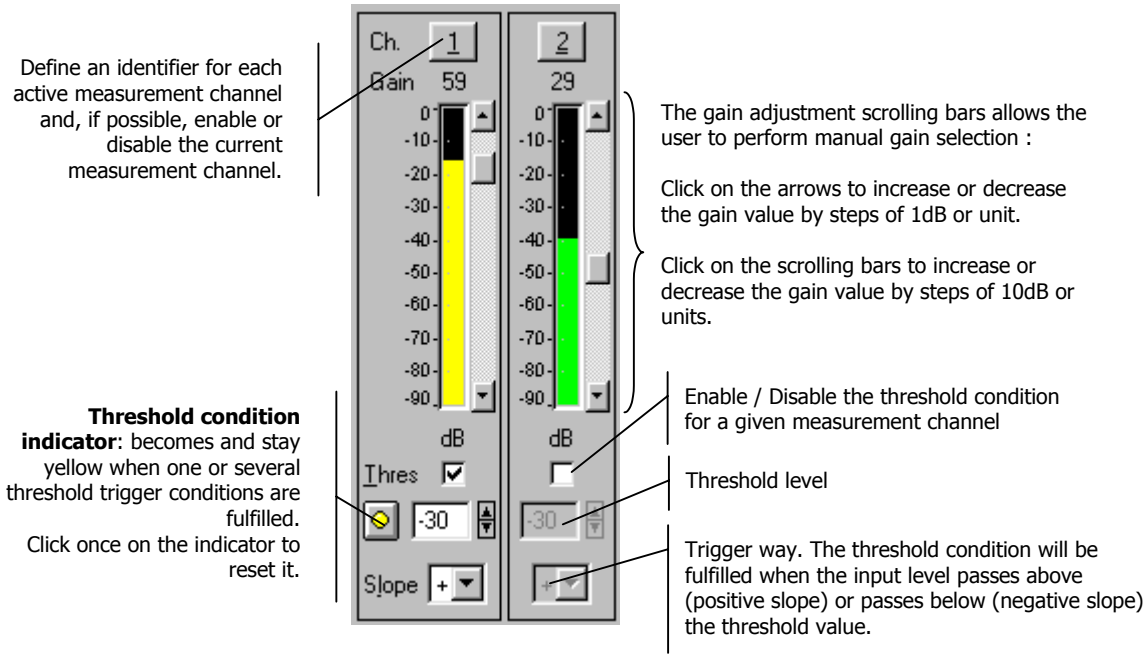
❑ **Units: Selection of the display unit of the input level.** The gain view meters may display the input levels according to three different units:

- **dB Phys**: Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
- **dB ADC**: Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
- **Unit**: Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s^2.

❑ **Trigger:** Define here the trigger parameters used for acquisition.

- **Trigger selection: Direct:** to start the measurement immediately after clicking on the start acquisition command or **Threshold:** to start the acquisition with a threshold condition (negative or positive) defined on the right hand side. The programme waits for the threshold, when the measurement start command is activated.
- **Trigger delay (in ms)**: For threshold triggering, it is possible to start the acquisition with a pre-delay or a post-delay in relation to threshold crossing. Input this delay or use the arrows up/down to increase/reduce the value
- **Operation**: Select a logical Boolean operator for the threshold trigger: **OR** to activate the recording if one of the conditions is fulfilled and **AND** to activate the recording when all conditions are fulfilled.

❑ **Channels**


Define an identifier for each active measurement channel and, if possible, enable or disable the current measurement channel.
Ch. 1
2
Gain 59
29
0 -10 -20 -30 -40 -50 -60 -70 -80 -90
dB
Thres
-30
Slope +
The gain adjustment scrolling bars allows the user to perform manual gain selection :
Click on the arrows to increase or decrease the gain value by steps of 1dB or unit.
Click on the scrolling bars to increase or decrease the gain value by steps of 10dB or units.
Threshold condition indicator: becomes and stay yellow when one or several threshold trigger conditions are fulfilled.
Click once on the indicator to reset it.
Enable / Disable the threshold condition for a given measurement channel
Threshold level
Trigger way. The threshold condition will be fulfilled when the input level passes above (positive slope) or passes below (negative slope) the threshold value.

13.3. Record configuration command

This command allows defining the rearming type after running a signal record (audio).

- **Manual**

The successive recordings are started manually by the user.

- **Automatic**

The successive audio recordings are started automatically (no user intervention is needed).

This option is only available in threshold triggering mode. Each time the threshold condition is fulfilled, a recording will be executed.

At the end of each recording, **dBBATI32** stores the new item in a measurement session datafile.

14. MLS ACQUISITION MODE

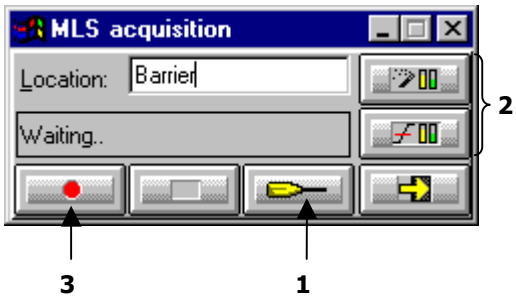
14.1. Set-up and measurement

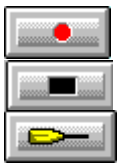
The acquisition in **MLS mode** (**Maximum Length Sequence**) is used for measurements of the impulse response of a given 'system'. It is based on the emission of a Binary Maximum Length Sequence (**BMLS**).

📖 ***Refer to annex 21.2 for more information.***

The command **Acquisition / MLS acquisition mode** to perform room impulse response measurements. Before proceeding with the MLS acquisition, two items have to be connected to the hardware platform:

- an amplified loudspeaker (noise source) connected to the output of the hardware platform, in order to generate the BMLS.
- connect one (or several) microphone(s) to input channel(s) to measure the system response

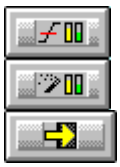




Start acquisition

Stop acquisition

Set-up the acquisition parameters



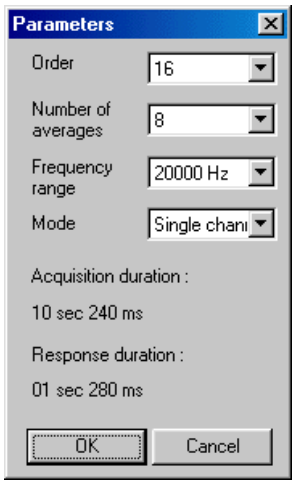
Gain settings

Autorange

Exit MLS acquisition mode

❑ Stage 1 : Set-up acquisition parameters

Use the icon to define the acquisition parameters in MLS mode. The dialogue box opposite appears on the screen.



This dialogue box allows the operator to define the **order** (which interact with the response duration), the **number of averages**, the **frequency range** and the measurement **mode**.

The **response duration** should be carefully selected, as it should be adapted to the geometry of the room.
Make sure that the response duration is long enough in order to obtain a background noise at the end of the measurement.

It is possible to **average** this response in order to decrease the effect of background noise.
The higher the average number, the better the response quality, because the influence of random phenomena (background noise) decreases. On the other hand, the acquisition duration increases (the signal to noise ratio increase by 3 dB when doubling the number of averages.

❑ **Stage 2 : Gain settings** **/ Autorange** **(see paragraph14.2)**

Select the gain setting command (automatic or manual).
These commands are used to adjust the dynamic range required for the measurement in order to eliminate surcharge and under loads during recording. Autorange is used when the sound levels to measure do not vary greatly over the acquisition duration.

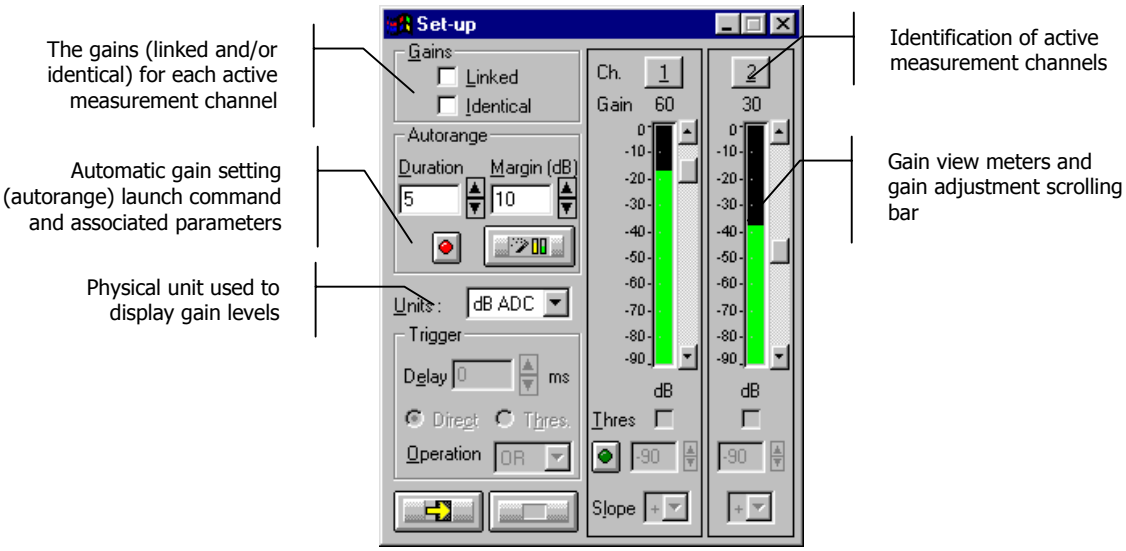
📖 *Threshold settings are not available in MLS acquisition mode.*

❑ **Stage 3 : Impulse response recordings**

Start the acquisition when the set-up operations have been carried out. Impulse responses are saved to the computer hard disk in a measurement session datafile (*.CMG) as an **impulse response** item.

14.2. Gain settings

This dialog box enables the definition of gain and threshold settings. These parameters can be used in several ways by the application software. All parameters and the available actions may be enabled or disabled according to the acquisition module, which calls this command.



❑ **Gains**
When the option **Linked** is active, the gains on all active measurement channels are modified: The gain setting of one active channel leads to identical modification on all active measurement channels.

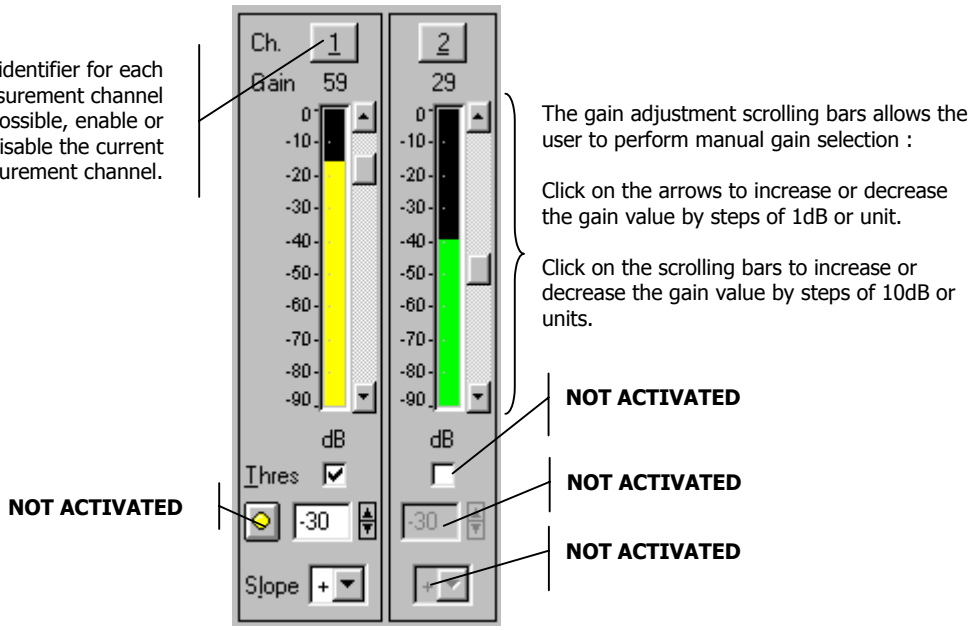
The gains on the active channels are identical, if the option **Identical** is activated. Each setting of one channel is passed to all other active channels. This option is only available if the option **linked** has been chosen.

❑ **Autorange** . Start automatic gain setting according to the input level on the hardware platform.

The autorange proceeds as follows: during the **duration,** defined in the dialogue box, the programme stores the highest reached value and adjust the gain so that this value is located "x" dB (**margin** defined in the dialogue box) below that maximum measured value.

- **Units: Selection of the display unit of the input level.** The gain view meters may display the input levels according to three different units:
  - **dB Phys**: Display the view meters in physical decibel. This is a relative level in dB calculated according to the transducer sensitivity and the reference 0 dB of the transducer type.
  - **dB ADC**: Display the view meters in converter decibel. This is a relative level in dB. The level 0 dB is defined as the full scale of the converter. The values in dB ADC are always negative between 0 and -90 dB.
  - **Unit**: Display of the view meters in physical units. In case the transducer is a pressure microphone, the view meter displays the values in Pascals (Pa). In case the transducer is an accelerometer, the view meter displays the values in m/s².

- **Channels**



15. MANAGEMENT OF MEASUREMENT SESSION DATAFILES (CMG)

Any data acquired in **dBBATI32** is stored in a **measurement session** datafile (extension *.CMG). From this datafile, the user can perform a given analysis (for example, calculation of an averaged spectrum from a signal recording).

From the measurement session window, it is possible to print tables of results and graphics, to copy and paste data items to a spreadsheet or word processor for further analysis and for editing a measurement report.

This chapter deals with the following aspects of data management:

- Create / Open / Save measurement sessions
- Description of the measurement session window and its toolbars
- Information window
- Comments
- Audio playback
- Edit/ Remove / Create data items
- Operations on data items (addition, subtraction, averaging, recombination, etc.)
- List / Plot data items
- Create / Edit / Print test reports
- Edit / Execute requests
- Print / Export / Copy the results
- General set-up of dBBATI32

15.1. CMG datafile management

A measurement session data file, with the CMG extension, may represent several megabytes of data and **dBBATI32** may work simultaneously on several data files.

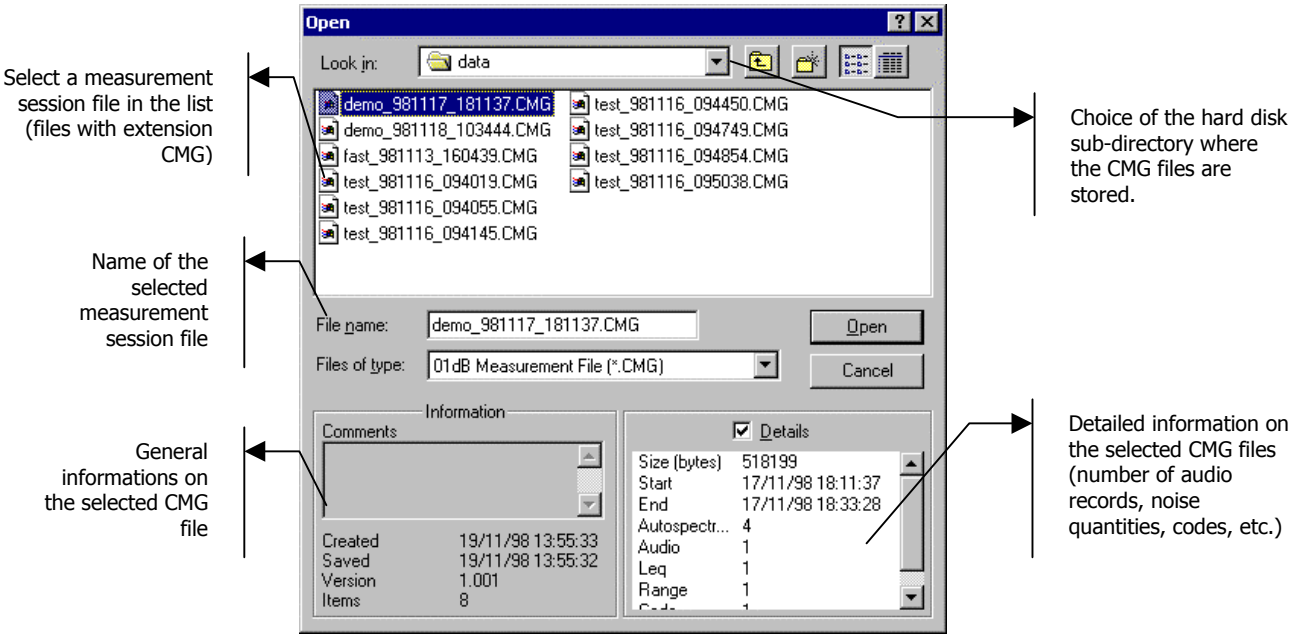
15.1.1.New CMG datafile

To create a new measurement session datafile CMG that is empty, click on the icon or use the command **File / New (CTRL+N)**.

An empty measurement session is then displayed on screen.

15.1.2.Open a CMG datafile

To open a CMG measurement session file stored on the computer hard disk, click on the icon or use the command **File / Open**. The following dialog box appears on screen.



The upper part of this dialog box allows the user to select a measurement session file CMG for processing in **dBBATI32** by choosing the appropriate location on the hard disk.
The lower part of this dialog box is activated when a CMG file has been selected in the list. Various information on the datafile are given such as:

- The date and time the file has been first recorded and when it was last saved, the version and the number of items contained in the CMG file.
- By ticking the **details** box, the size in bytes of the datafile, the start and end dates of the measurements, the number of events (audios, spectrums, etc.) as well as general parameters (dynamic range, number of codes, etc.)

Once a file has been selected, click on the **Open** button to open the datafile and proceed with its analysis.

15.1.3.Close a CMG datafile

To close a measurement session file of type CMG, use the command **File / Close**. Closing down the window of the datafile will also result in closing the CMG datafile. All others windows (results' listings, plots, etc.) will be closed as well.

dBBATI32 will also prompt the user to save this CMG datafile if any modifications have been made to it before closing.

15.1.4.Save a CMG datafile

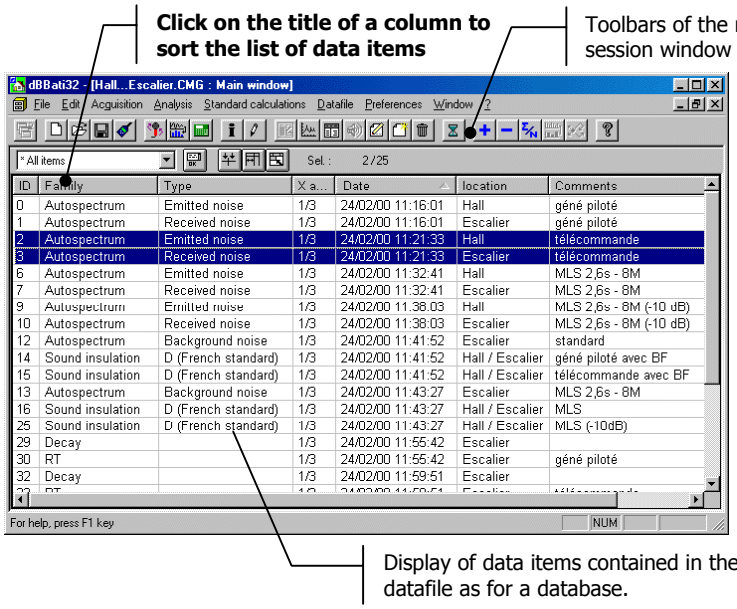
Use the command **File / Save (CTRL+S)** or **File / Save As** to save the measurement session on the computer hard disk.

15.1.5.Delete one or several CMG datafile(s)

Use the command **File / Delete session(s)** to delete one or several measurement session datafiles, including temporary files. A dialog box is displayed on screen in order to select the datafiles to delete..

15.2. Measurement session window overview

In the measurement session window, the data items are displayed as for a database. Each line corresponds to a given type of data and each column corresponds to a given type of information about this data.


Click on the title of a column to sort the list of data items
Toolbars of the measurement session window
dBBati32 - [Hall...Escalier.CMG : Main window]
File Edit Acquisition Analysis Standard calculations Datafile Preferences Window ?
* All items
Sel : 2/25
ID Family Type X a... Date location Comments
0 Autospectrum Emitted noise 1/3 24/02/00 11:16:01 Hall géné piloté
1 Autospectrum Received noise 1/3 24/02/00 11:16:01 Escalier géné piloté
2 Autospectrum Emitted noise 1/3 24/02/00 11:21:33 Hall télécommande
3 Autospectrum Received noise 1/3 24/02/00 11:21:33 Escalier télécommande
6 Autospectrum Emitted noise 1/3 24/02/00 11:32:41 Hall MLS 2,6s - 8M
7 Autospectrum Received noise 1/3 24/02/00 11:32:41 Escalier MLS 2,6s - 8M
9 Autospectrum Emitted noise 1/3 24/02/00 11:38:03 Hall MLS 2,6s - 8M (-10 dB)
10 Autospectrum Received noise 1/3 24/02/00 11:38:03 Escalier MLS 2,6s - 8M (-10 dB)
12 Autospectrum Background noise 1/3 24/02/00 11:41:52 Escalier standard
14 Sound insulation D (French standard) 1/3 24/02/00 11:41:52 Hall / Escalier géné piloté avec BF
15 Sound insulation D (French standard) 1/3 24/02/00 11:41:52 Hall / Escalier télécommande avec BF
13 Autospectrum Background noise 1/3 24/02/00 11:43:27 Escalier MLS 2,6s - 8M
16 Sound insulation D (French standard) 1/3 24/02/00 11:43:27 Hall / Escalier MLS
25 Sound insulation D (French standard) 1/3 24/02/00 11:43:27 Hall / Escalier MLS (-10dB)
29 Decay 1/3 24/02/00 11:55:42 Escalier
30 RT 1/3 24/02/00 11:55:42 Escalier géné piloté
32 Decay 1/3 24/02/00 11:59:51 Escalier
For help, press F1 key
NUM
Display of data items contained in the datafile as for a database.

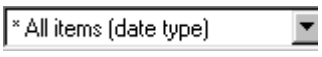
The horizontal toolbars allows the user to perform general and data processing operations for the data items contained in the measurement session.

Select data items in the list and perform the desired operation.

15.2.1. Toolbars

The following operations are possible for the data items contained in a measurement session file. According to the type and number of items selected in the list, some operations may not be activated.

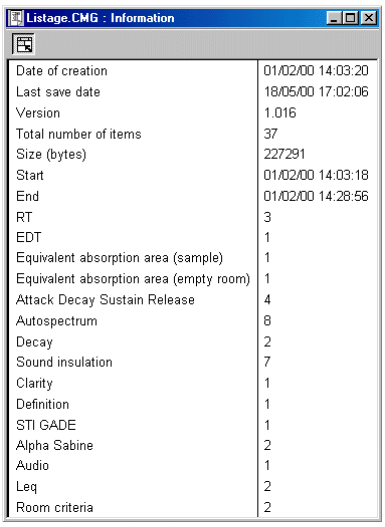
- Create an empty measurement session file (CTRL + N)
- Open an existing measurement session file (CTRL+O)
- Save the active measurement session file (CTRL+S)
- Transfer data from a sound level meter
- Activate the next window of dBBATI32 (CTRL + TAB)
- Open an existing measurement manager (*.GSM)
- Open an existing analysis manager (*.GSA)
- Open an existing computation manager (*.GSC)
- Display an information window about the measurement session
- Edit the general comment of the measurement session
- Automatically generate a test report
- Plot (graphics) the selected data items
- List (table) the selected data items
- Playback the selected audio events
- Modify a data item (date, level correction, etc.)
- Create a data item (Level or RT spectrum)
- Delete the selected items
- Access batch processing analysis
- Add the selected items
- Subtract the selected items
- Average the selected items
- Recombine in octaves a third-octave spectrum
- Compute RT spectrum from time decays
- Open the index on the on-line help system. ***(Contextual help accessed by the F1 key).***



Sort data items according to the selected request

- Edition of requests
- Select the window columns to display
- Automatically adjust the width of each column
- Automatically adjust the size of the measurement session window

15.2.2.Measurement session information window



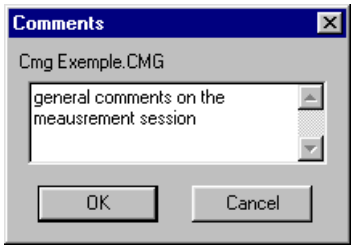
Use the command **Datafile / Session Information** to display the information window of the active measurement session.

The following information is given in this window:

- Date of creation and last modification
- Number of data items contained in the datafile
- Datafile size
- Start and end date and time
- Number of data items of each family

This list is updated automatically each time a modification is made into the measurement session datafile.

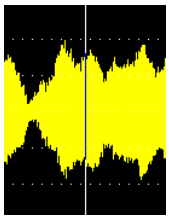
15.2.3.Measurement session comments



Use the command **Datafile / Session comments** to input a general comment for the active measurement session datafile.

15.2.4.Playback audio events

Select an audio event in the list and use the command **Datafile / Replay** to playback an audio event through the sound system of the computer (signal output of **SYMPHONIE HARMONIE, JAZZ** or integrated sound card). The dialog box shown aside is displayed on-screen during playback.



When a plot is displayed, a **vertical cursor** follows the progress of the playback on this plot.

15.2.5.Delete data items

Select the data items to remove in the list and use the command **Edit / delete** or the **Suppr** function key. After confirmation of the deletion, the data items are completely removed from the measurement session file.

Use the command **Preferences / Measurement sessions** not to activate the confirmation of data items removal.

15.2.6.Modify data items (edition)

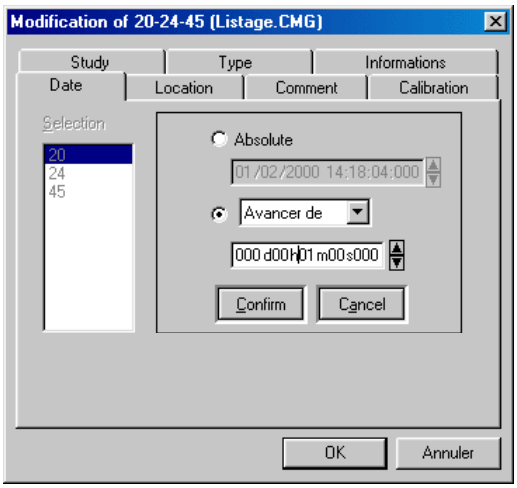
Select one or several data items in the list and use the command **Datafile / Modify** to edit general parameters of these items. The user may modify the following parameters for each item:

- The start date and time
- The location and comment defined during acquisition
- The study zone of the item

Furthermore, it is possible to apply a calibration correction (level in dB) for some given types of data items.

Each item is identified in the measurement session by its **identifier (ID).** This identifier is a number.

15.2.6.1.Edition of items : date and time

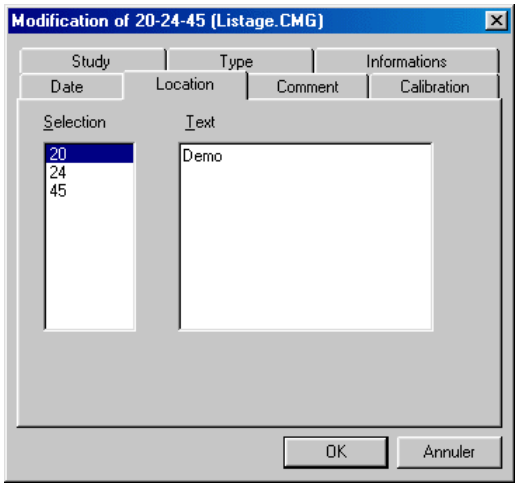


In the **Date** tab, edit the date and time values, corresponding to acquisition start, of the selected data items.

The modification can be performed in an **absolute** manner (direct edition of the date and time) or by bringing forward or putting back the original date by a user-defined duration (format : Day / hour / minutes / seconds / milliseconds).

The user has to **confirm** each date and time modification.

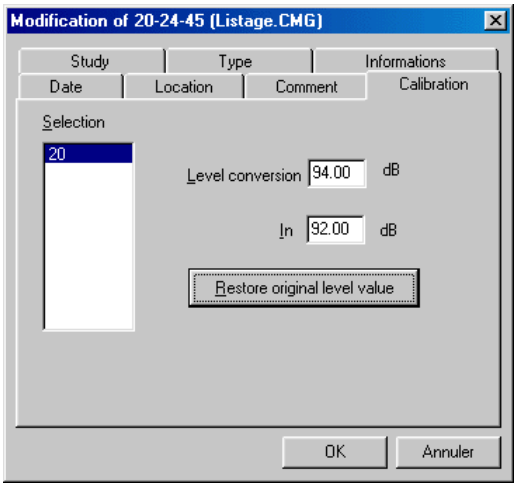
15.2.6.2.Edition of items : location and comments



In the **Location** tab, edit the comment relative to the location of the measurement channel.

In the **Comment** tab, edit the comment relative to, for example, the measurement conditions.

15.2.6.3.Edition of items : Level conversion

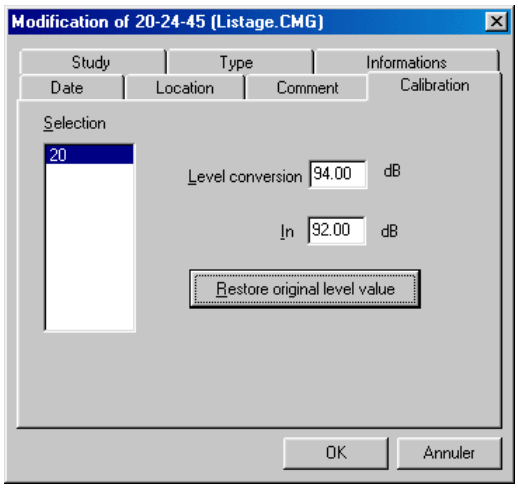


In the **calibration** tab, define a calibration adjustment for the selected data items.

A calibration level conversion in decibels is applied globally with a resolution of 0.01dB.

Click on the key **Restore original level value** to cancel the level correction.

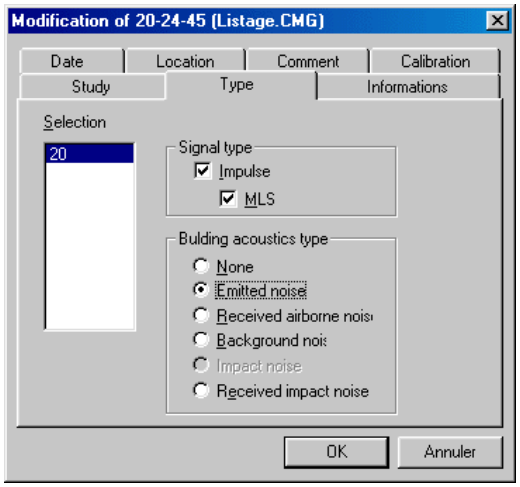
15.2.6.4.Edition of items : study zone



In the **study** tab, select the study zone for any subsequent analysis.

Click on the **Complete study** key to select the complete duration of the data item for an analysis.

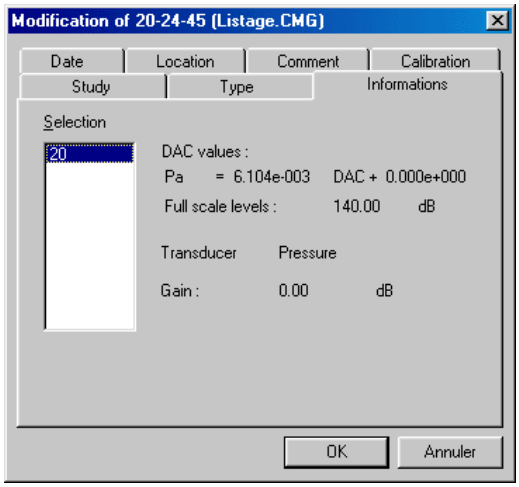
15.2.6.5.Edition of items : Type for building acoustics



In the **Type** tab, select the type of a given autospectrum or audio file for building acoustics calculations.

*The spectra resulting from a measurement in **dBBATI32** already have the correct type.*

15.2.6.6.Edition of items : Information



- **DAC conversion value**

Conversion value allowing us to pass directly from the digital value measured on the acquisition card to the analogue value expressed in Pascals. This value depends on the sensitivity of the transducer and the gain used.

Example : For the hardware platform Symphonie, sampling is performed over 16 bit, with values ranging from -32768 to +32768.
For a digital value of 5000, the level in Pascals is 5000 * DAC. Thus : 5000 * 3.432e-4 = 1.716 Pa

- **Full scale level**

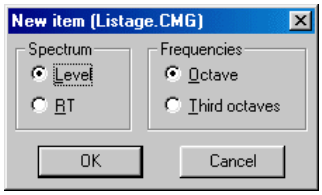
Maximum value in decibels that can be measured with the current DAC value.

For Symphonie, this value is equal to : **20 log ((32768*DAC) / P_0) in dB**
with a reference sound pressure level P_0 = 20 mPa

- **Transducer type** used to acquired the audio data
- **Gain** for the input signal

15.2.7.Create new data item

Use the command **Datafile / Create** to add a new data item (spectrum or RT spectrum) to the active measurement session. The data values will be edited manually. The dialog box shown below appears on screen.

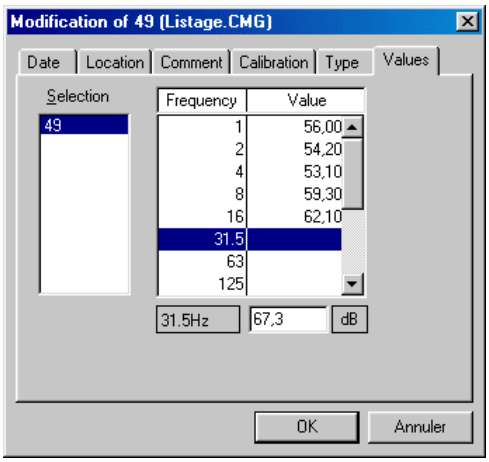


Select the type of **spectrum** (level in dB or RT in seconds) as well as the **frequency** resolution (octaves or third octaves). Click on the OK button

The data item modification dialog box appears on screen (**Values** tab). Then, input manually the values of the spectrum for each frequency band (in seconds or in dB).

The user is not obliged to input a value for each frequency band.

*It is possible to input a location, a comment and to give a particular type to this spectrum by using the other tabs of this data item. Refer to **paragraph 15.2.6**.*



15.2.8.Operations on data items

The following icons allows the operator to perform a serie of operations on data items selected in a measurement session datafile.

Add all selected data items (spectrum, audio, RT) and create a new data item containing the result.

Subtract all selected data items (spectrum, audio, RT) and create a new data item containing the result.

Average all selected data items (spectrum, audio, RT) and create a new data item containing the result.

*The 3 above arithmetic operations may be carried out according to two calculation rules : **algebraic** or **logarithmic**. Use the command **Preferences / Operations** to select which rule will be used (see **paragraph 15.8.5.5**).*

Recombine a third octave spectrum into an octave spectrum (autospectrum or time decays only) and create a new data item containing the result.

Compute a RT spectrum from a time decay data item selected in the measurement session. Use this function if the RT spectrum corresponding to a given time decay has been deleted from the measurement session.

*Use the command **Preferences / Operations** to select how the RT calculation will be carried out (see **paragraph 15.8.5.5**).*

15.3. Plot data items (graphics)

Use the command **Datafile / Plot**, after selection of one or several data items in the list, to display the data in a graphical manner, when possible. Double click on a data item in the list to also display a graphical view.

Data items of the following types may be displayed graphically in **dBBATI32**:

Signal edition view

- Signal recording (audio)

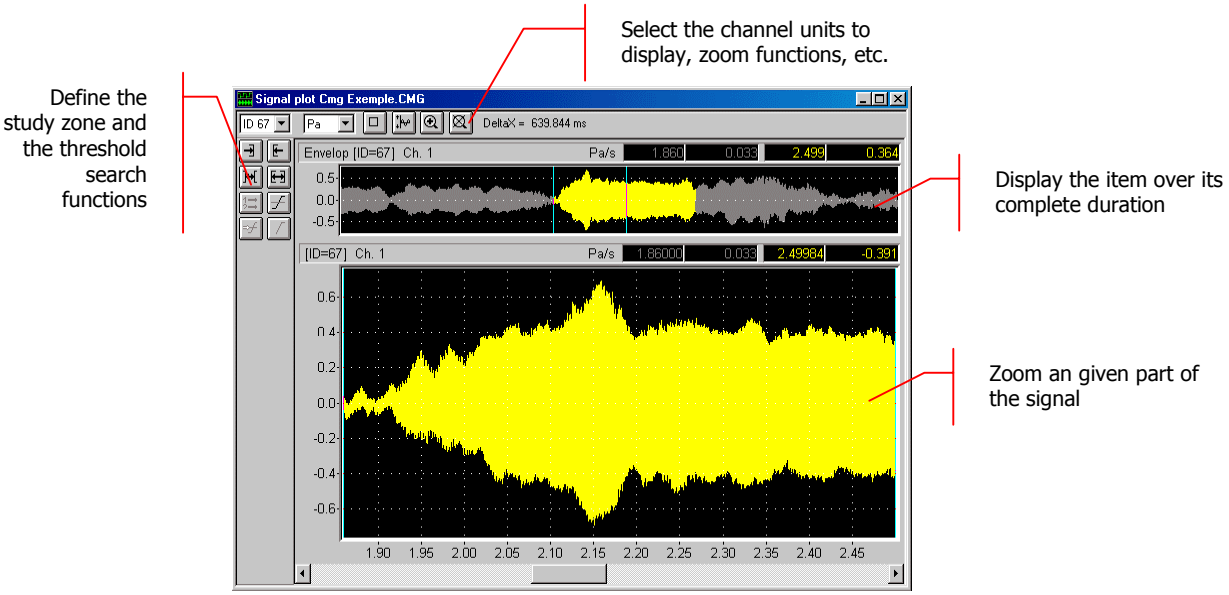
Broad band spectrum and/or multispectrum view

- Octave, third octave, 1/Nth octave band spectra
- Reverberation time in octaves and third octaves

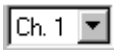
Let now describe each view in the following paragraphs.

15.3.1.Signal view

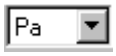
In this type of graphical view, any time history of a signal (in physical units), noise and vibration quantity (level in dB or in physical units) can be displayed. An example of signal view is given below:


Select the channel units to display, zoom functions, etc.
Define the study zone and the threshold search functions
Signal plot Cmg Exemple.CMG
Display the item over its complete duration
Zoom an given part of the signal

The toolbar of this graphical view allows the user to perform the following operations:



Select the active channel for the view



Select the display unit

Activate/ Deactivate automatic autoscale for the zoom

Perform an autoscale in the signal zoom view

Activate the zoom view

Deactivate the zoom view

Beginning of the study zone

End of the study zone

Define the study zone in between the cursors

Define the study zone over the complete duration of the item

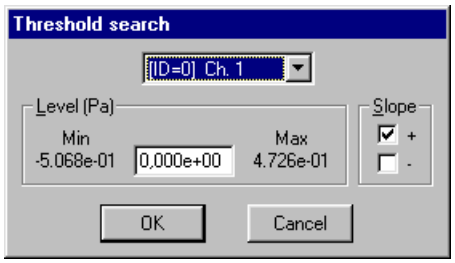
Show/Hide a channel and activate/deactivate a channel for any subsequent study

Search for a threshold exceedance

Stop threshold search

Next threshold

The vertical toolbar allows the user to define the study zone for the signal and to perform threshold search operations.



The threshold search command (command **Study / Threshold / Search)** allows the user to define the level of the threshold (value given in physical unit) and a slope (positive or negative) to the threshold condition.

When the threshold condition has been fulfilled, the cursor is located at the threshold exceedance on the graphical view.

The command allows the user to stop the threshold search and the command allows the user to find the next threshold exceedance.

The horizontal toolbar allows the user to define display parameters of the graphical view. It is possible to use **zoom** functions to zoom a part of the signal and perform an **autoscale** for the zoom view.

The display units depend of the type of graphical view.

For **signals**, it is possible to select the following display units:

- **ADC** : Displays the dynamic in dB converter. It's a relative decibel level. The 0dB level is the full-scale value of the converters (i.e. a sample which has a numerical value of 2 16 (32767) corresponds to the 0dB value). dBADC values are always negative between 0 and -90dB.
- **V** : Dynamic display in Volts.
- **Physical unit** : If the transducer is a microphone, he dynamic is displayed in Pascals (**Pa**), If the transducer is an accelerometer, the dynamic is displayed in Acceleration (**m/s^2**).

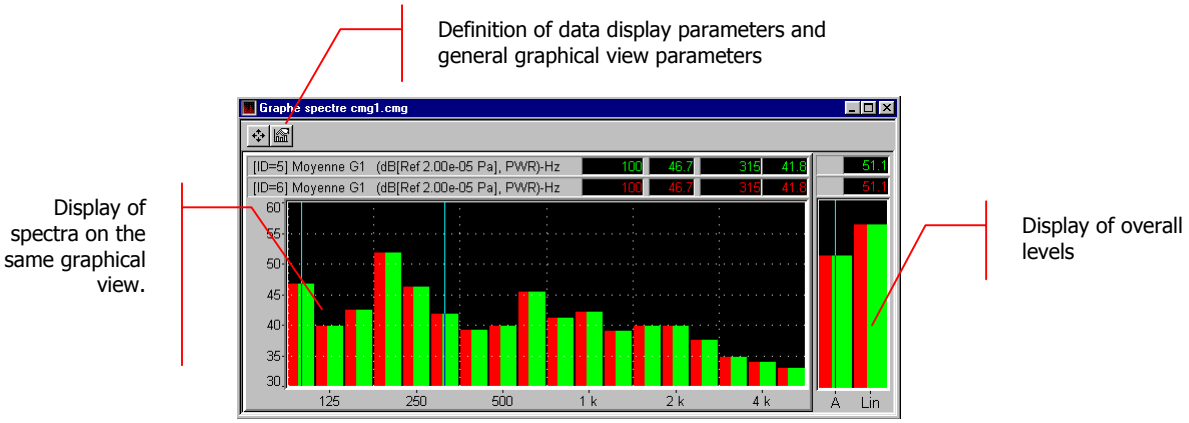
For sound and vibration quantities of type autospectrum, cross-spectrum and transfer functions, it is possible to select the following display units:

- **dB** : Level in decibels of the considered quantity (Leq, Slow, Fast, Impulse, etc…)
- **RMS (Root Mean Square)** : Average quadrate value for all the instantaneous squared values expressed in physical units.
- **PWR (Power)** : The power represents the average of a squared value. It is the unit used to determine the power at a given frequency for a determined (sinusoidal) signal. It is expressed in squared units

It is possible to display up to two signals on the same graphical view if the data items have the same characteristics (periods, duration).

15.3.2.Broad band spectra view

This type of view is used to graphically display spectra in broad bands (octaves, third octaves), An example of this type of view is given below::



The toolbar of the graphical view allows the user to perform the following operations:

Definition / Edition of data parameters for the graphical view

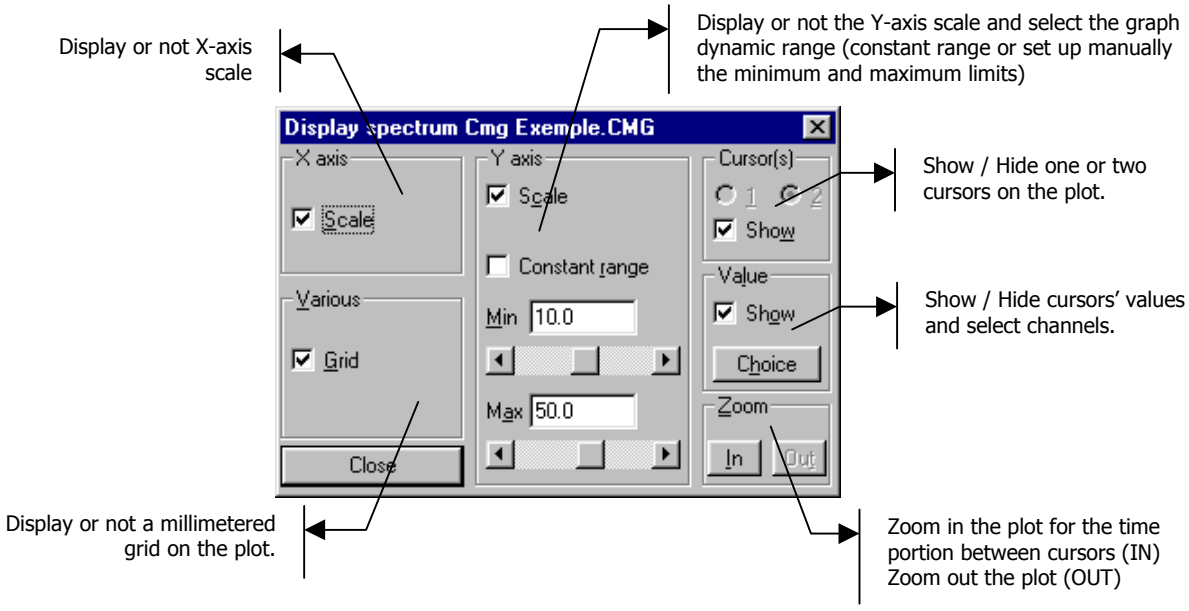
Definition / Edition of display parameters for the graphical view

It is possible to display up to 6 data items on the same view if they have the same characteristics (periods, resolution).

15.3.2.1.Display parameters of the graphical view

Set-up the graphical display parameters by the command **Plot / Plot set-up**.

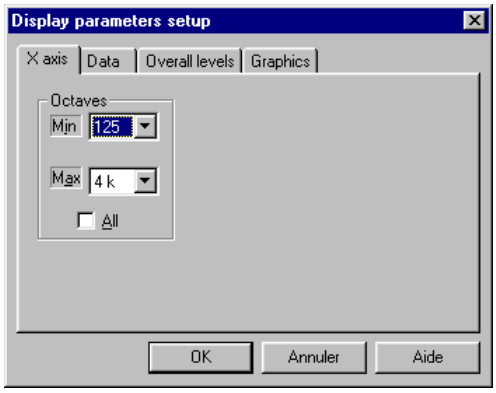
The plot is updated immediately when a modification is made. Each plot has its own settings' dialog box: a modification on one plot does not affect the settings of another plot.



15.3.2.2.Data parameters for the graphical view

Define data parameters for the graphical view by the command **Plot / Parameters**. The following dialog box appears on-screen. The tabs allows the user to define the following parameters:

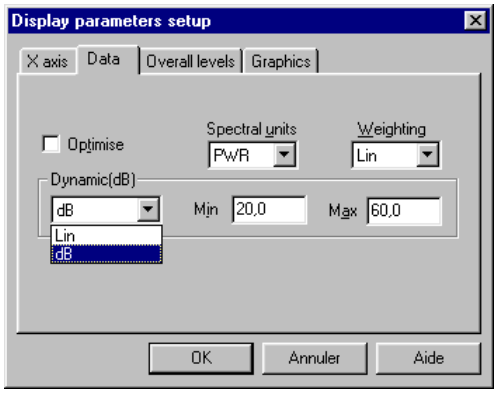
- **X axis tab**



In this tab, select the minimum and maximum frequency bands for spectrum display in the graphical view.

If the **All** box is ticked, the spectrum is displayed over the complete frequency range of acquisition.

- **Data tab**

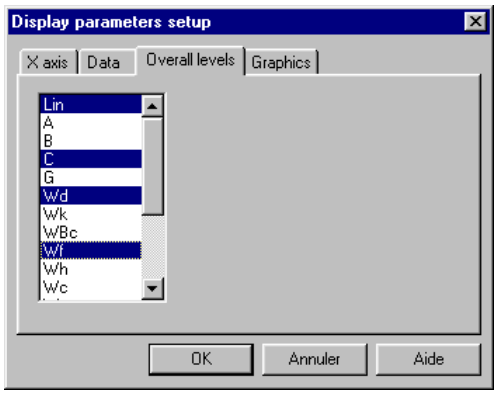


In this tab, select if the data should be displayed in physical units (**Dynamic : Lin**) or in decibels (**dB**).

Then select the required spectral unit (**RMS** or **PWR** for broad band spectra and multispectra) as well as frequency weighting to apply to the spectral data values.

If the **Optimise** box is not ticked, the user may then select the minimum and maximum values of the display dynamic range.

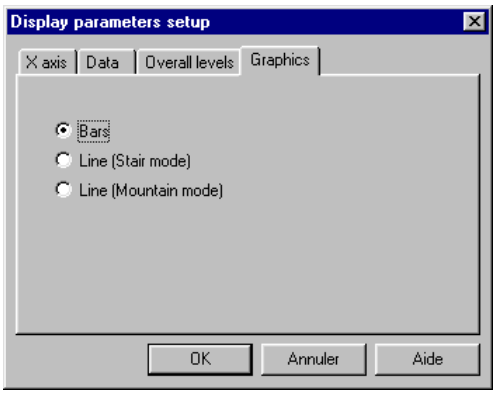
- **Overall levels tab (broad band spectra)**



In this tab, and for broad band spectra only, select the overall levels to compute according to a given frequency weighting, displayed in a list.

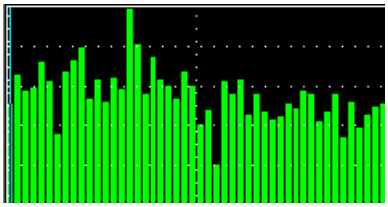
Overall levels are then displayed on the right hand side of the spectrum view.

- **Graphics tab**

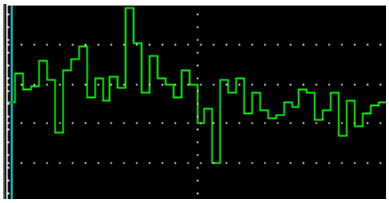


In this tab, select the type of graphics that will be displayed : line mode or bars mode.

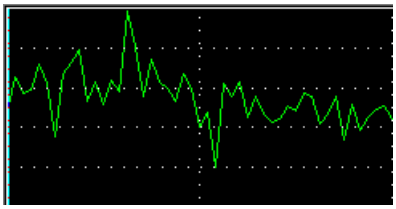
Examples of the different types of graphical representation are given below:



Bars mode



Line mode (stairs)

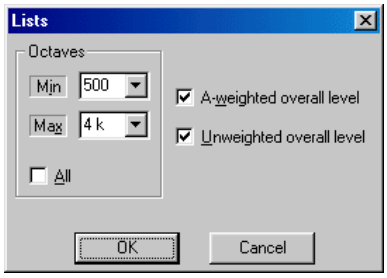


Line mode (mountain)

15.4. Listings of data items (tables)

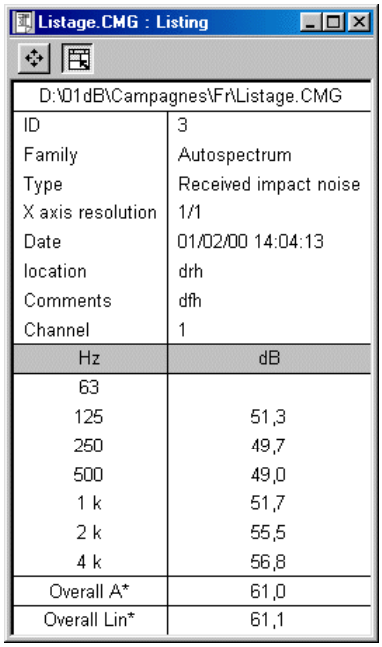
Use the command **Datafile / List**, after selection of one or more data items in the list, in order to display data items as a table of results. The user can also double click on the items of interest to display the table of results.

Broad band spectra may be displayed as tables in **dBBATI32.**



Select the minimum and maximum frequency bands for spectrum data values in the table of results..
If the **All** box is ticked, the spectrum values are listed over the complete frequency range of acquisition.

Select the overall levels to compute according to a given frequency weighting, displayed in a list (A and Lin levels).



The levels are listed in decibels (**dB**) PWR.
Overall levels are shown at the bottom of the table.

The toolbar of the table of results allows the user to perform the following operations:

Definition / Edition of data parameters for the table of results

Automatically adjust the size of the window

15.5. Automatic test reports

It is possible to create, edit and print test reports automatically after performing standard calculations in **dBBATI32**. These test reports comply with the specifications of the ISO standards currently in use.

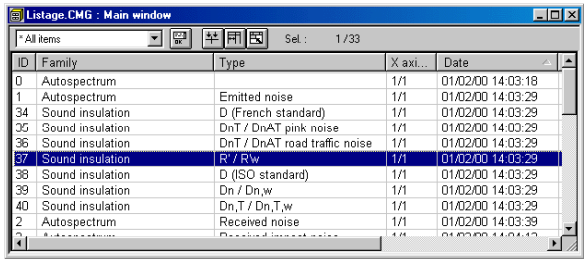
📖 ***Refer to paragraph 21.4 for details on the standards and the computation methods used.***

❶ Select a data item in the measurement session datafile

Select in the measurement session data file a data item that result from a standard calculation.

All data items obtained from the computation manager (insulation, impact noise, mechanical equipment noise, absorption) may be used to create automatically a test report.

The icon is activated when a compatible data item for the creation of a test report has been selected.


Listage.CMG : Main window
* All items
Sel. : 1 / 33
ID | Family | Type | X axi... | Date
0 | Autospectrum | | 1/1 | 01/02/00 14:03:18
1 | Autospectrum | Emitted noise | 1/1 | 01/02/00 14:03:29
34 | Sound insulation | D (French standard) | 1/1 | 01/02/00 14:03:29
35 | Sound insulation | DnT / DnAT pink noise | 1/1 | 01/02/00 14:03:29
36 | Sound insulation | DnT / DnAT road traffic noise | 1/1 | 01/02/00 14:03:29
37 | Sound insulation | R' / Rw | 1/1 | 01/02/00 14:03:29
38 | Sound insulation | D (ISO standard) | 1/1 | 01/02/00 14:03:29
39 | Sound insulation | Dn / Dn,w | 1/1 | 01/02/00 14:03:29
40 | Sound insulation | Dn,T / Dn,T,w | 1/1 | 01/02/00 14:03:29
2 | Autospectrum | Received noise | 1/1 | 01/02/00 14:03:39

Absorption :

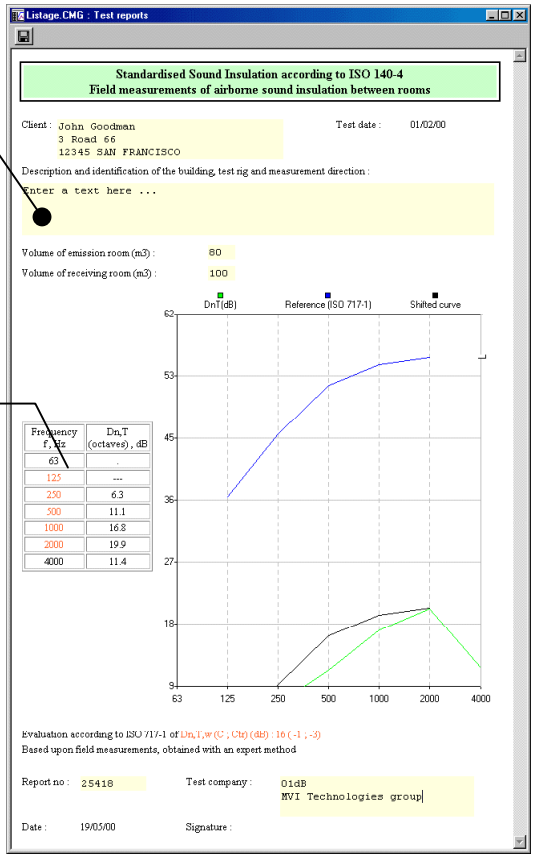
- The item A1 (equivalent sound absorption of an empty room) cannot be used to create a test report, because this item is only used to check that other sound absorption indices are valid..
- The two RT items that have been used for computation in the report must be saved in the measurement session datafile.

❷ Generation of the test report

Use the command **Datafile / Test report** to automatically generate a test report in HTML format.

The fields that appear in light yellow may be modified by the user

The layout and the number of graphics and tables in the report depend upon the data item selected in the datafile


Listage.CMG : Test reports
Standardised Sound Insulation according to ISO 140-4
Field measurements of airborne sound insulation between rooms
Client : John Goodman
3 Road 66
12345 SAN FRANCISCO
Test date : 01/02/00
Description and identification of the building, test rig and measurement direction :
Enter a text here ...
Volume of emission room (m3) : 80
Volume of receiving room (m3) : 100
DnT(dB)
Reference (ISO 717-1)
Shifted curve
Frequency f, Hz | Dn,T (octaves), dB
63 | ---
125 | ---
250 | 6.3
500 | 11.1
1000 | 16.8
2000 | 19.9
4000 | 11.4
Evaluation according to ISO 717-1 of Dn,T,w (C ; Ctr) (dB) : 16 (-1 ; -3)
Based upon field measurements, obtained with an expert method
Report no : 25418
Test company : 01dB
MVI Technologies group
Date : 19/05/00
Signature :

The test report window features some fields that filled automatically by **dBBATI32** and other ones that the user has to complete, to identify the measurement.

The **Description** field is automatically completed with the location and comments of the selected data item.

As default, the fields **Client** and **Test Company** are empty. It is possible to complete manually these fields, and there will be used again for all subsequent reports by using the command **Preferences / Fields of test reports** (see below).

The parameters that have been used for the computation of the data item (selected in the computation manager) cannot be modified.
However, in some reports, other parameters may be completed manually.

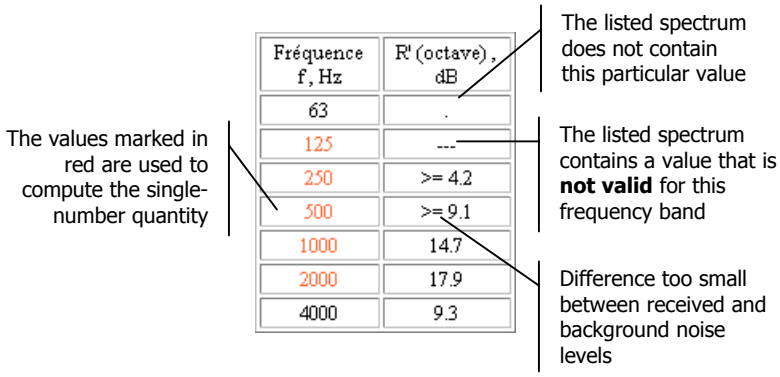
- **Definition of default fields for the test reports**

Use the command **Preferences / Fields of test reports** to define as standard the references of the client and the company that performed the test, featured on each test report.

This operation allows the user to save time when editing a test report, but it is always possible to edit manually within a particular test report.

- **Table of values**

The table of values featured in the test reports uses symbols and colours explained below :



❸ Save the test report

Use the command **Report / Save** or **Rapport / Save As** to save the complete test report in a HTML file (standard format for web browsers).

Open a test report on another computer :
The graphic display in the report uses a Java applet that is installed as standard with 01dB programs. This applet must be present on the computer to display correctly the graphics of a report.

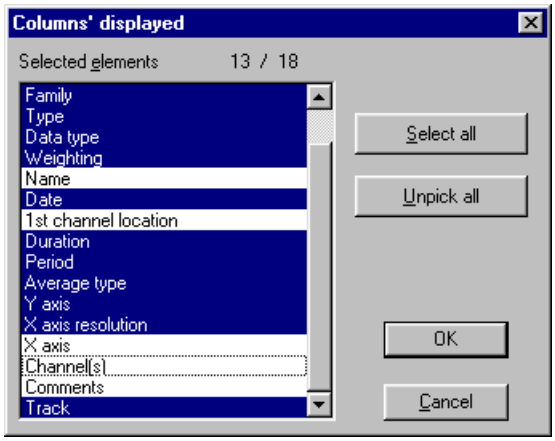
Proceed as follow to display a test report :
- On the PC where **dBBATI32** is installed, copy the **Com** directory, located in the directory where 01dB software applications have been installed.
- Copy this directory on the PC, at the exact same location on the hard disc, where the test report is displayed.

❹ Printing the report

Use the command **File / Print** to print the test report. The user modifications (fields) in the test reports are taken into account before the print operation.

15.6. Description and selection of columns in a measurement session window

Use the command **Datafile / Columns** to select the columns that will be displayed in the main window of a measurement session data file. The dialog box shown below appears on screen.



Select with the mouse the different column fields that will be displayed in the main window of a measurement session data file.

The key **Select all** allows the user to select all possible columns fields while the key **Unpick all** allows the user to clear all the column fields.

The table below gives the meaning of column available in a measurement session window:

Columns	Meaning
Selection (Sel.)	When selecting several data items in the measurement session window, a number is shown in this column that displays the selection order of the data items.
ID	Identifier of the data item. A number. This number is incremented (from 0)each time a data item is added to the measurement session.
Family	Set of data items of the same family : audio, autospectra, transfer functions, etc.
Type	Type of a given spectrum (emitted noise, received noise, etc. for building acoustics)
Data type	Type of quantity allowing us to define more accurately the data item (for a Fast sound pressure level, the family would be Leq and the data type will be Fast)
Weighting	Frequency weighting applied to the data item during acquisition or off-line analysis : A, B, C, Lin weightings, vibration weightings, etc.
Name	Name of the analysis that created this data item. It is the name of the operator for a off-line analysis and the name of the acquired quantity for a real-time measurement.
Date	Date and time of the data item, corresponding to the date of creation or modification
1st channel location	Location defined during acquisition (Channel 1 by default). For cross spectra, it corresponds to the location of the first measurement channel.
Duration	Duration of the data item (hour / minutes / seconds)
Period	Base duration or integration time of data items that vary with time.
Average type	Type of averaging method used to compute the data item (average, min., max., statistical)
Y axis	Physical unit (or dB for the histograms) of the Y axis
X axis resolution	Resolution of the X axis (in seconds for time histories of data items, frequency resolution for spectrum data items)
X axis	Unit of the X axis (Hz, seconds, %, etc.)
Channel(s)	Number of the measurement channel on which the data item has been acquired
Comments	Comments of the data item, from measurement set-up or item modification
Track	For off-line analysis, this field indicates how this data item was computed : ID of the original data item, name and type of operators used to compute the result)

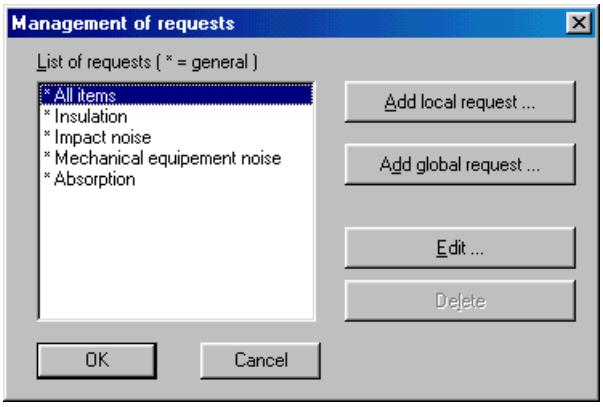
15.7. Edition and execution of requests (data sorting)

Measurement session datafiles have a structure similar to databases. As any measurement result is stored into these datafiles, a set of requests functions allow the user to sort the data according to various parameters. One can display, for example, data items of the same family only (audio events, narrow band spectra, octaves and third octave spectra, etc.) in the measurement session view.

The simplest way to sort data is to click on a column field in the measurement session

15.7.1.Overview of requests' edition

Use the command **Datafile Edition of requests** to open the dialog box that allows the user to define, edit or remove requests.



dBBATI32 manages two types of requests: **local requests**, which apply only to the active measurement session, and **global requests**, which apply to any measurement session. Global requests are preceded by an asterisk (*).

The procedure to define a request is the same in both cases.

Click on the key **Add local request** to add a new local request to the active measurement session and click on the key **Add global request** to add a new global request for any measurement session that will be opened in the application software.

Click on the key **Edit** to modify an existing request selected in the list and click on the key **Remove** to remove an existing request from the list. By default, 5 types of requests are available :

- *** All items**
  Sort data items of a measurement session according to their dates of creation.

- *** Insulation**
  Display only the data items of the measurement session that deals with Insulation : Emitted noise, received airborne noise, RT, background noise and the results of sound insulation calculations.

- *** Impact noise**
  Display only the data items of the measurement session that deals with Impact noise : Received impact noise, TR, RT, background noise and the results of impact noise calculations.

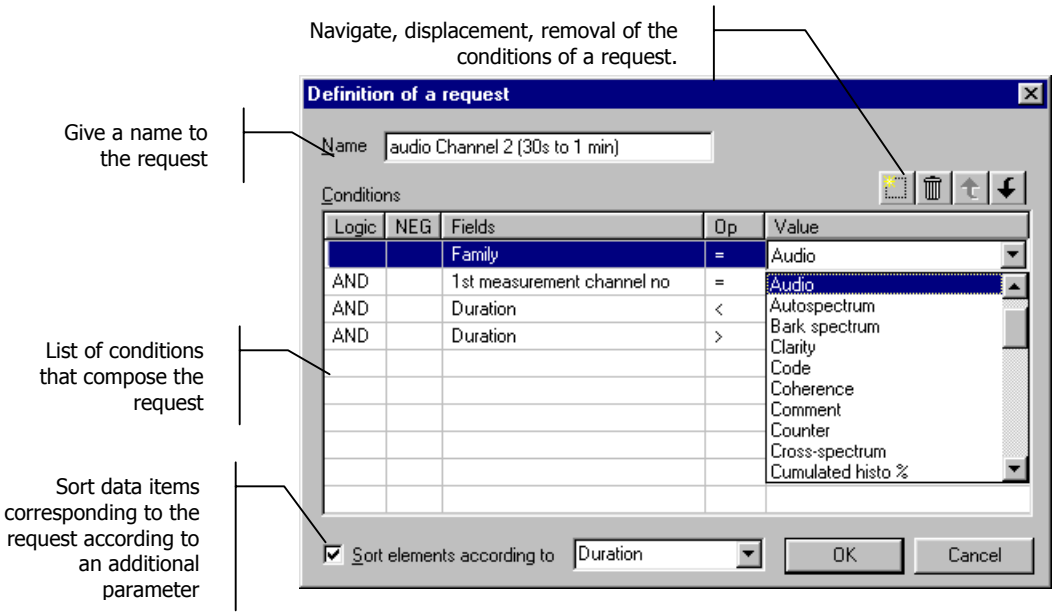
- *** Mechanical equipment noise**
  Display only the data items of the measurement session that deals with equipment noise : equipment noise level, RT and standardised equipment noise level.

- *** Absorption**
  Display only the data items of the measurement session that deals with absorption : RT and the results of sound absorption calculations.

15.7.2.Add or modify a request (local or global

15.7.2.1.Overview

Access the dialog box shown below when creating a new request or editing an existing request.



After definition of the request name (that will appear in the list of requests), define one or several conditions that compose the request. The columns of the list of conditions of a request allows the user to define the following parameters:

- **Logic column**

  Define a Boolean operator (**AND/OR**) when several conditions have been defined. The data items will be displayed when all the conditions of the request are verified (**operators AND**) or at least one condition is verified (**operators OR**).

- **NEG column (negative)**

  If this case is activated, the data items that will be displayed are the items that do not correspond to the condition.

- **Fields column**

  Select the quantity according to which the data items will be sorted. A list proposes all the fields that characterise data items (family, name, ID, duration, etc.)

- **Op column (operation)**

  Equality, inequality of the quantity selected in the Fields column.

- **Value column**

  Value that takes the quantity selected in the Fields column. The operation of the Op column forms the condition of the request.

Furthermore, a tool bar allows the user to perform the following operations:

Insert a condition in the list at the current mouse location

Remove the condition selected in the list

Move up the condition selected in the list (appears in video inverse)

Move down the condition selected in the list (appears in video inverse)

The definition order of the conditions is important : indeed, the boolean operator (logic column) of the last condition defined is applied to all the conditions that precede it.

For example, for a set of conditions to verify simultaneously (AND operator in between each condition), on), if the operator for the last condition is OR, then the request will display data items that match all the conditions associated by the AND operator as well as the data items that match the last condition.

The example below illustrates the principle:

Logic	NEG	Fields	Op	Value
		Family	=	Audio
AND		Duration	<	0h01m00s000
AND		Duration	>	0h00m30s000

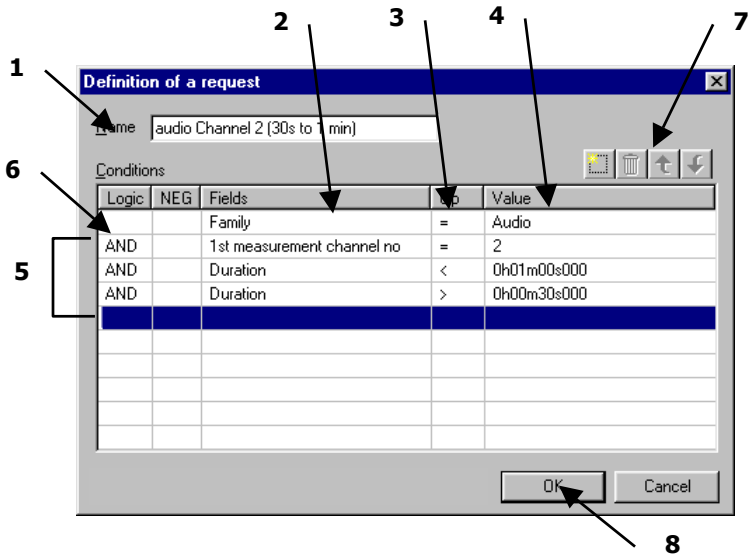
Data items of the Audio family and of duration ranging from 30 seconds to 1 minute will be displayed.

Logic	NEG	Fields	Op	Value
		Family	=	Audio
AND		Duration	<	0h01m00s000
OR		Duration	>	0h00m30s000

Data items of the Audio family and of duration greater than 30 seconds will be displayed as well as data items (whatever the family) of duration less than 1 minute.

15.7.2.2.Definition principle

Follow the instructions below to add a new request:



1. Give a **name** to the current request. This name will appear in the list of request in the management dialog box.
2. On the first line of the conditions' list, click on the **Fields** column and select the desired quantity in the scrolling list.
3. On the same line, click on the **Op** column and select the equality value in the scrolling list.
4. On the same line, click on the **Value** column and select a value in a scrolling list or input it manually.
5. Repeat steps 2 to 4 for each condition to define
6. Select the boolean operators in the Logic column to define interactions in between the conditions.
7. Define the order of the request conditions, remove a condition if necessary
8. Validate the request.

15.7.2.3.List of the values available to define a request

Here is a complete table of the different choices available when defining a request.

Fields column	Description (Fields column)	Op column	Value column
1/n octave	Frequency resolution of a broad band spectrum or multispectrum	< ; <= ; <> ; = ; > ; >=	n = 1, 3, 6, 12, 24, 48
Application	Name of the application software used to create the item	@, =	Manual input
Date	Date of creation of the item	< ; <= ; <> ; = ; > ; >=	Manual input (day/month/year hh:mm:ss). 01/02/1999 16:42:05
Duration	Duration of an item	< ; <= ; <> ; = ; > ; >=	Manual input (ddd/hh/mm/ss/ms) 30 seconds : 000j00h00m30s000
Family	Set of data items of the same family : audio, autospectra, transfer functions, etc.	= ; <>	attack decay sustain release, audio, autospectrum, clarity, code, coherence, comment, counter, room criteria, EDT, transfer functions (1/H1, H1, 1/H2, H2), histogram (%, Nb), cumulated histogram (%, Nb), Intensity (active, reactive, free field), cross-spectrum, sound insulation, Leq, measurement, mean pressure, psycho, RASTI, impulse response, sensitivity, Bark spectrum, scalar spectrum, STI, TI, TR
Data type	Type of quantity allowing us to define more accurately the data item (for a Fast sound pressure level, the family would be Leq and the data type will be Fast)	= ; <>	Peak, Fast, Fast Inst., Fast Max, Fast Min, Impulse, Impuls Inst, Impuls Max, Impuls Min, instantaneous, Isel, Leq, Min, RC, RC Inst., RC Max, RC Min, SEL, Slow, Slow Inst, Slow Min, Slow Max, Tmax 3, Tmax 5
X axis quantity	Physical unit of the X axis	= ; <>	Bark, dB, Hz, Order, Scalar
Y1 axis quantity	Physical unit of the Y-axis. For cross-spectra, Y1 corresponds to the physical unit of the first item and Y2 corresponds to the physical unit of the second item used to calculate the cross spectrum	= ; <>	Acceleration, counter, displacement, force, jerk, Noy, pressure, rate, rate (DC), second, scalar, sone (D, F, GD, GF), voltage, velocity, W/m²
Y2 axis quantity			
ID	Identifier of the data item. A number. This number is incremented (from 0)each time a data item is added to the measurement session.	< ; <= ; <> ; = ; > ; >=	Manual input of a number
1st channel location	Location defined during acquisition (Channel 1 by default). For cross spectra, it corresponds to the location of the first measurement channel.	@ ; =	Manual input of a location
Average type	Type of averaging method used to compute the data item	= ; <>	Max, Min, Average, Stat
1st meas. Channel no	Number of the measurement channel used to create the item. For cross-spectra, the number of each channel used to calculate the cross spectrum is described	< ; <= ; <> ; = ; > ; >=	1, 2, 3, 4
2nd meas. Channel no			
Name	Name of the analysis that created this data item. It is the name of the operator for a off-line analysis and the name of the acquired quantity for a real-time measurement.	@ ; =	Manual input

Fields column	Description (Fields column)	Op column	Value column
Period	Base duration or integration time of data items that vary with time.	< ; <= ; <> ; = ; > ; >=	Manual input (0,00000 seconds) 125 ms : 0.12500
Weighting	Frequency weighting applied to the data item during acquisition or off-line analysis : A, B, C, Lin weightings, vibration weightings, etc.	= ; <>	A, B, C, D, G, Lin, PL, Pla, PN, Pink A, Pink Lin, Road A, Road Lin, TPN, Wb, WBc, Wc, Wd, We, Wf, Wh, Wj, Wk
Building acoustics spectrum	Type of a given spectrum (emitted noise, received noise, etc. for building acoustics	= ; <>	Background noise, emitted noise, received noise
Statistics	Statistical index Ln	< ; <= ; <> ; = ; > ; >=	Manual input (0,00000) L99.8 : 99,8000
X axis unit	X axis unit for a quantity acquired with other software (not 01dB)	@ ; =	Manual input
Y1 axis unit	X axis unit for a quantity acquired with other software (not 01dB). For example, the temperature For cross-spectra, Y1 corresponds to the physical unit of the first item and Y2 corresponds to the physical unit of the second item used to calculate the cross spectrum	@ ; =	Manual input
Y2 axis unit			
Version	Version of the file format	< ; <= ; <> ; = ; > ; >=	Manual input (0,00000) Version 1.01 : 1,01000

Legend:

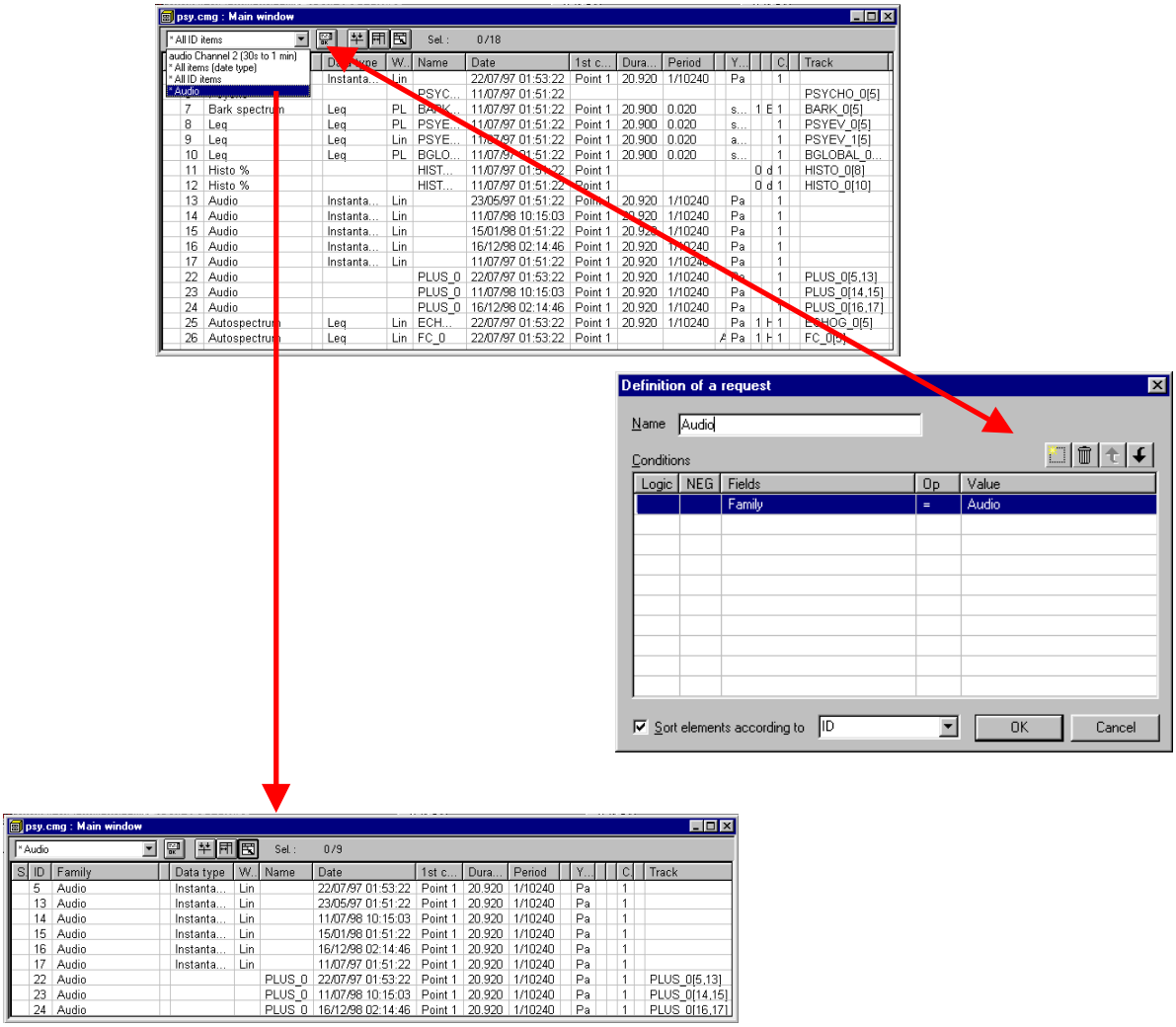
<	Less than
<=	Less than or equal to
<>	Not equal to
=	Equal to
>	Greater than
>=	Greater than or equal to
@	Contain the character string

15.7.3.Execute a request

Once all the requests have been defined, use the scrolling list

of the measurement session window or the **command Datafile / Current request**.

The selected request is then executed automatically. An example of execution of a request to display only items of the audio family is given below:

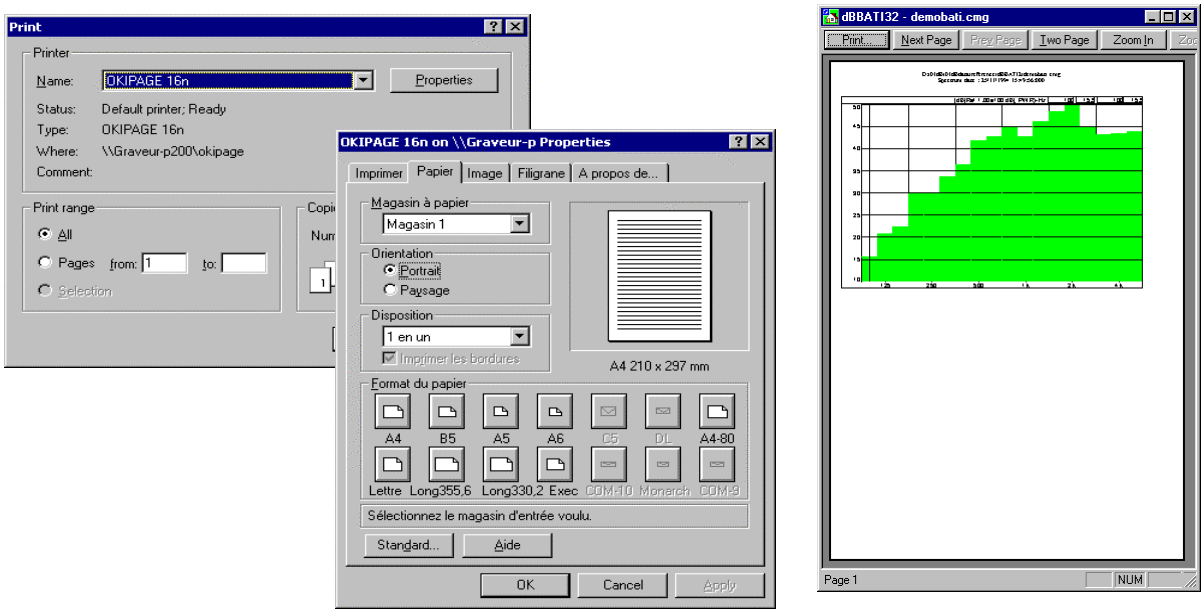


15.8. Result exploitation and customisation

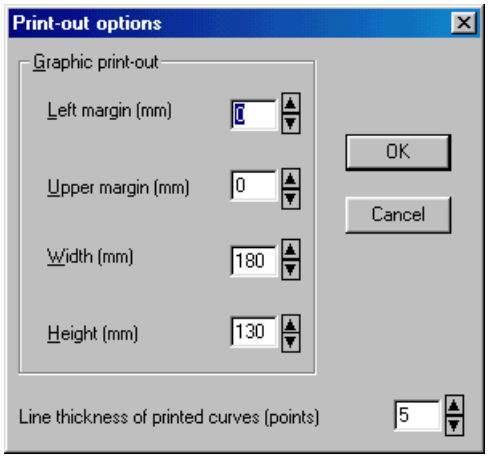
It is possible in **dBBATI32** to print directly a data plot and/or a result listing and to export the results as graphics or values in standard office spreadsheet and word processor software, for further processing and result presentation. The user can also customise the way the data is displayed in the software.

15.8.1.Printing results

Using the commands of the **File** menu, results can be directly printed by **dBBATI32**, if a printer is connected to the computer, of course. Use the command **File / Print** (**CTRL + P**) to display the Print dialog box. Specify which pages should be printed, the number of copies, and the printer driver to use as well as other parameters (print quality, etc.).



Access directly to the printer configuration dialog box by the command **File / Print Set-up** and to a preview of the document to print by the command **File / Print Preview.** The toolbar of the print preview window allows the user, for example, to zoom in the preview document.

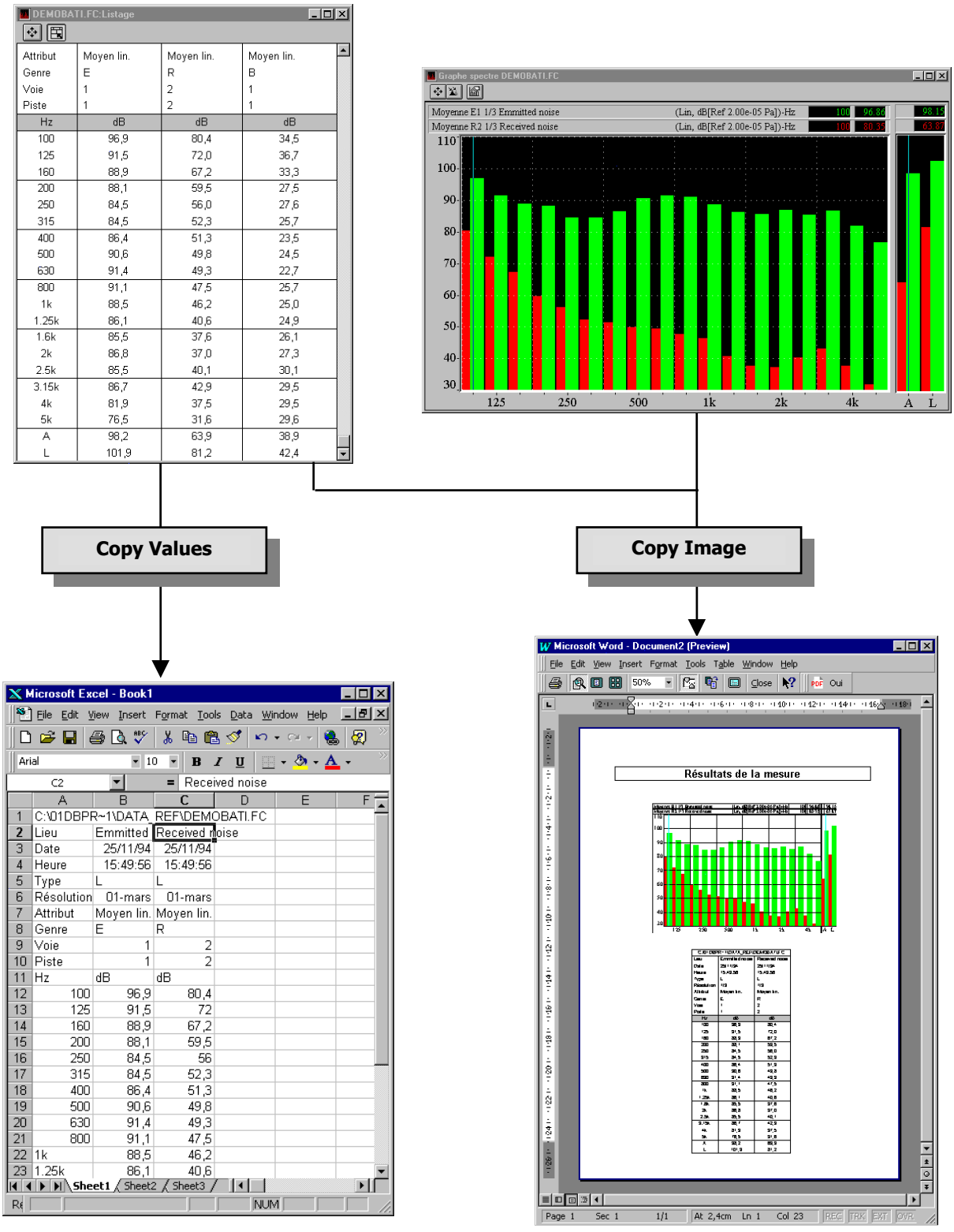


When printing graphics, the user can set a few additional parameters by the **commands Preferences / printout options.**

The user can set the margins of the graphic printout frame and the line thickness of the printed curves.

15.8.2.Export data to a word or spreadsheet processor

The user may either export results as graphics (graphical plots and results listings) or export the results as values by the command **Edit / (CTRL+C)**. After the copy command of **dBBATI32**, simply paste (Edit / Paste) the data in a word processor or a spreadsheet processor as shown below:

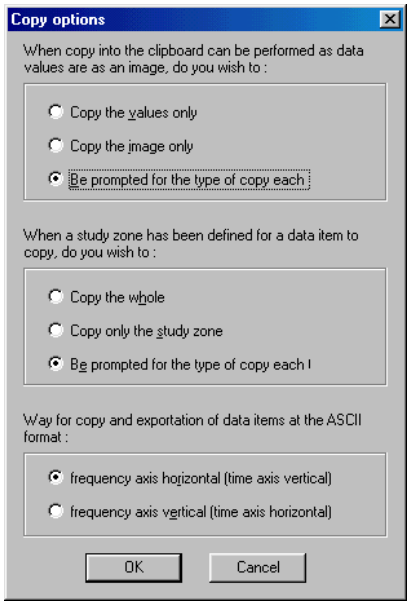


Attribut	Moyen lin.	Moyen lin.	Moyen lin.
Genre	E	R	B
Voie	1	2	1
Piste	1	2	1
Hz	dB	dB	dB
100	96,9	80,4	34,5
125	91,5	72,0	36,7
160	88,9	67,2	33,3
200	88,1	59,5	27,5
250	84,5	56,0	27,6
315	84,5	52,3	25,7
400	86,4	51,3	23,5
500	90,6	49,8	24,5
630	91,4	49,3	22,7
800	91,1	47,5	25,7
1k	88,5	46,2	25,0
1.25k	86,1	40,6	24,9
1.6k	85,5	37,6	26,1
2k	86,8	37,0	27,3
2.5k	85,5	40,1	30,1
3.15k	86,7	42,9	29,5
4k	81,9	37,5	29,5
5k	76,5	31,6	29,6
A	98,2	63,9	38,9
L	101,9	81,2	42,4

15.8.3.Principle and configuration of the Copy command

The copy command may be configured to work in different ways in **dBBATI32**. Use the command **Preferences / Copy options** to define how the copy command will work. The following dialog box appears on screen.

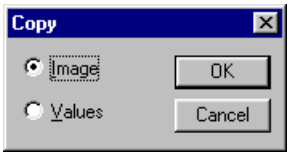
By default, for all graphical views, the command **Edit / Copy** can be used to copy the image of the graphical view. The data values cannot be copied


Copy options
When copy into the clipboard can be performed as data values are as an image, do you wish to :
Copy the values only
Copy the image only
Be prompted for the type of copy each
When a study zone has been defined for a data item to copy, do you wish to :
Copy the whole
Copy only the study zone
Be prompted for the type of copy each t
Way for copy and exportation of data items at the ASCII format :
frequency axis horizontal (time axis vertical)
frequency axis vertical (time axis horizontal)
OK
Cancel

- **Copy of tables of results**

In some cases, for a table of results mainly, it is possible to copy either an image of the table or the data values of the table at the ASCII format.

The default option **Be prompted for the type of copy each time** allows the user to display a dialog box for choosing to copy either the image or the values of the table of results

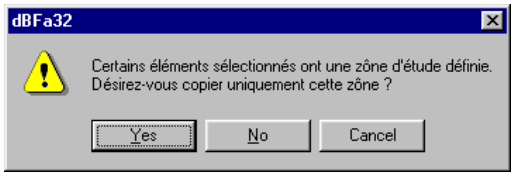


The option **Copy the values only** can be used to copy directly the data values. The option **Copy the image only** can be used to directly copy the image of the table.

- **Copy of an item when a study zone has been defined**

For items where a study zone can be defined (an audio signal for example), it is possible to copy the image of the view over the complete duration of the item (option **Copy the whole)** or to copy only the image of the view over the defined study zone (**Copy only the study zone**).

The default option **Be prompted for the type of copy each time** allows the user to display a message to either copy the image of the view over the complete duration or the study zone. The following message appears on screen:



*See **paragraph 15.2.6** for more details on defining a study zone.*

- **Copy data items at ASCII format**

When copying directly data items from the measurement session window at ASCII format, an additional parameter is the way it will be pasted in a word or spreadsheet processor.

The data values can be displayed **vertically** (default value) : data of X-axis and Y-axis are displayed in columns. Alternatively, they can be displayed **horizontally** : data of X-axis and Y-axis are displayed in lines.

15.8.4.Exportation of data at ASCII format (TXT file)

The command **File / Export** allows the user to copy the data values of one or several items of a measurement session datafile at the ASCII format into a TXT file.

A wide range of application software packages may open these files: Windows notepad, word processors, spreadsheet processors, database software, etc. The user can perform any operation on the formatted data to edit a measurement report or to perform further calculations.

Each field in the ASCII file is separated from the next one by a tabulation, in order to easily import these files into a spreadsheet processor.

We give below an example of ASCII file containing data from a sound insulation spectrum:

Id 9
Identifier number of the measurement.

Ident Name ISOL_0
Comment
Origin dBOper32
These fields correspond to the fields of a 01dB measurement session (*.CMG files) : The name of the operator that allowed the user to perform the calculations, the comment associated to the item, the origin of the computation.

Family Sound insulation
Set of data items of the same family : audio, autospectra, etc.

Data Type Leq
Type of quantity allowing us to define more accurately the data item (for a Fast sound pressure level, the family would be Leq and the data type will be Fast)

Type
Type of a given spectrum (emitted noise, received noise, etc. for building acoustics)

Begin 25/11/94 15:49:56
End 25/11/94 15:49:56
StudyBegin 25/11/94 15:49:56
StudyEnd 25/11/94 15:49:56
Start and end date and time of an item, Start study zone date and time of the item.

Period 0,000e+00
Base duration or integration time of data items that vary with time. Set to 0 when the items are time averaged.

Average
Type of average applied to the item (mean, maximum, minimum)

Average Duration
Averaging duration for a spectrum

Where emitted noise
Defined location for the measurement session..

Coord
Unit dB
Physical unit of the measured data. For noise levels, Pascal (Pa) is used. As the sound insulation calculation has been performed from spectra in decibels, the unit is the decibel.

PowerUnit PWR
The power represents the average of a squared value. It's the unit used to determine the power at a given frequency for a determined (sinusoidal) signal. It is expressed in squared units

Reference 1,000e+00
Reference value of the measured quantity for level conversion in decibels. For sound pressure levels, the reference value of the international system is $2x10^{-5}$ Pa. Here, the reference is equal to 1 because sound insulation calculation has been performed from spectra in decibels, the unit is the decibels.

dB/Lin dB
Unit of the stored quantity. Here, the levels are directly given in decibels (dB). For a time decay, for example, the values are given in physical units (Lin)

Weight Lin
Frequency weighting applied to the data

Partial 3
X unit Hz
X Min 100 Hz
X Max 5 kHz
Partial corresponds to the broad band resolution of the spectrum: 1 means Octave, 3 means Third octave**. X unit** corresponds to the physical unit of the X-axis: In this example, we are dealing with Frequency in Hertz (Hz). **X Min** and **X Max** correspond respectively to the minimum and maximum frequency bands of acquisition (in this example, we consider third octave bands ranging from 100Hz to 5kHz).

Nb Elements 1
Number of data values contained in the item.

100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz
	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz					
16,5	19,5	21,7	28,7	28,5	32,3	35,2	40,8	42,1	43,6	42,3	45,5
	47,9	49,8	45,3	43,9	44,4	44,9					

The data values are given for each frequency band.

We give below the example of a data item of an averaged spectrum (averaging time of 30 seconds) in octave bands

Id	0	1	2
...			
Family	Autospectrum	Autospectrum	Autospectrum
Data Type	Leq	Leq	Leq
Type			
Begin	10/05/99 14:38:41	10/05/99 14:38:41	10/05/99 14:38:41
End	10/05/99 14:38:41	10/05/99 14:38:41	10/05/99 14:38:41
...			
Period	0,000e+00	0,000e+00	0,000e+00
Average	Average	Max	Min
Average Duration	3,000e+01	3,000e+01	3,000e+01

The field average type can be: Average for an averaged spectrum, Max for a maximum spectrum, Min for a minimum spectrum.

Where	#19	#19	#19
...			
Unit	Pa	Pa	Pa
PowerUnit	PWR	PWR	PWR
Reference	2,000e-05	2,000e-05	2,000e-05
dB/Lin	dB	dB	dB
Weight	Lin	Lin	Lin
Partial	1	1	1
X unit	Hz	Hz	Hz
X Min	31.5 Hz	31.5 Hz	31.5 Hz
X Max	4 kHz	4 kHz	4 kHz

The three fields above are added for averaged spectra. **Partial** corresponds to the broad band resolution of the spectrum: 1 means Octave, 3 means Third octave**. X unit** corresponds to the physical unit of the X-axis: In this example, we are dealing with Frequency in Hertz (Hz). **X Min** and **X Max** correspond respectively to the minimum and maximum frequency bands of acquisition (in this example, we consider octave bands ranging from 100Hz to 5kHz).

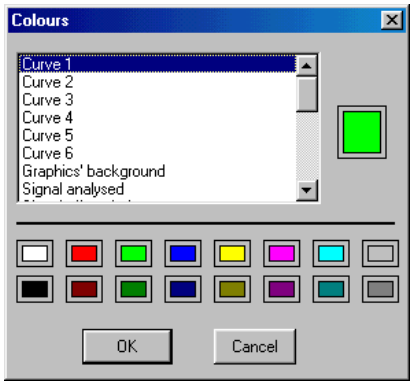
Nb Elements	1	1	1
31.5 Hz	55,7	56,3	50,7
63 Hz	57,5	58,2	49,4
125 Hz	72,8	73,3	65,6
250 Hz	73,1	74,0	61,2
500 Hz	69,9	71,0	49,0
1 kHz	62,3	63,8	39,4
2 kHz	60,7	61,9	38,0
4 kHz	66,3	67,5	47,2

The data values are given for each frequency band

15.8.5.Customisation of dBBATI32

The software allows the user to customise various parameters for displaying the data.

15.8.5.1.Select the colours of the data to display

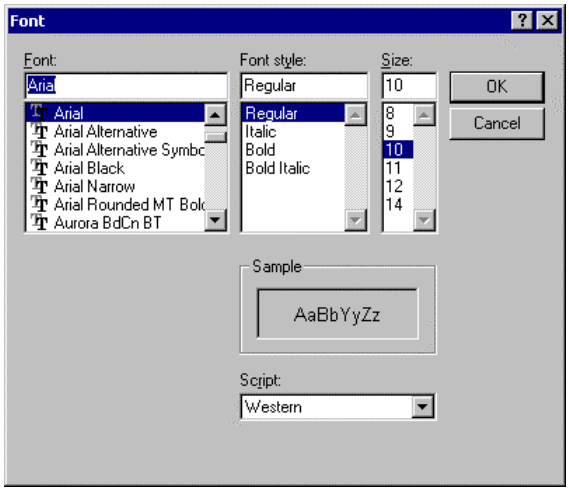


The commands **Preferences / Colours** allows the user to respectively set the colours of the different types of data displayed on screen.

Select in this list the type of data for which you want to modify the colour. The actual colour associated to this type of data is displayed next to the list. Then, select with the mouse the new colour in the bottom part of the dialog box.

Click on **OK** when all the modifications have been carried out

15.8.5.2.Select the fonts of the data to display



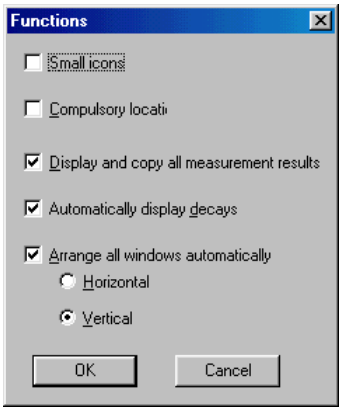
The command **Preferences / Font** allows the user to choose which computer font will be used to display text in **dBBATI32**.

Select the font type, style (regular, Italic, Bold, etc.) and size in this dialog box.

Click on **OK** when all the modifications have been carried out..

15.8.5.3.General functions

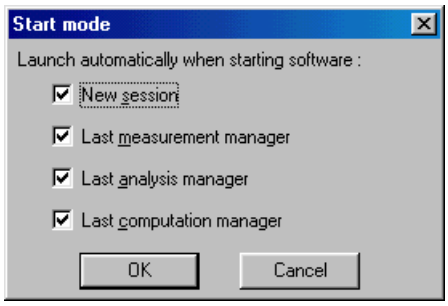
The command **Preferences / Functions** allows one to customise the software :



- **Small icons** : Tick this option to display small icons in the manager toolbars.
- **Compulsory location** : Tick this option in order to oblige the user to input a location for any next data item.
- **Display and copy all measurement results**
- **Automatically display decays** : The decay edition window is displayed automatically after a measurement or an analysis of reverberation time, or room criteria.

- **Arrange all windows automatically** : all windows within the software will be arranged automatically in the main window, either vertically or horizontally.

15.8.5.4.Start options



The command **Preferences / Start** allows to open automatically some elements when opening the application software.

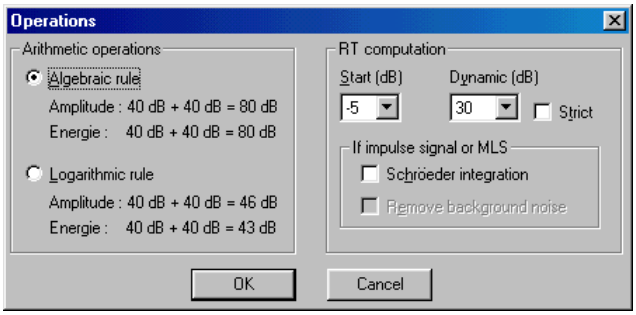
15.8.5.5.Parameters for operations on data items

The command **Preferences / Operations** allows the operator to modify the default parameters of the calculations on data items.

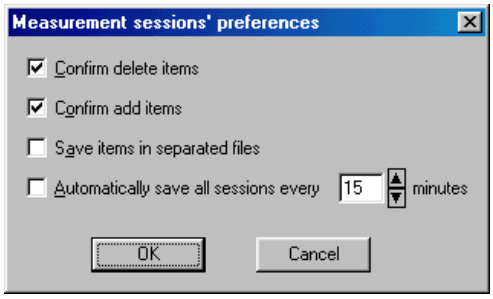
The choice of the rules (algebraic or logarithmic) for arithmetic operations is applied to the addition, subtraction and averaging operations.

The RT computation parameters apply to RT calculation operation.

*Refer to **paragraph 15.2.8** for further information.*



15.8.5.6.Measurement session general options



Use the command **Preferences / Measurement session** to define general parameters about the management of measurement session datafiles.

The option **Confirm delete items** allows the user to display a dialog box to confirm or not any item removal operation in the active measurement session datafile.

The option **Confirm add items** allows the user to display a dialog box to confirm or not any item addition in the active measurement session datafile.

The option **save items in separated files** allows the user to save the different items of a measurement session files into binary files. The binary data of each item are stored in a BID (Binary Item Data) file and the references of this item are saved into the measurement session itself.

The option **Automatically save all sessions every X minutes** allows the user to save all the opened measurement sessions at regular time intervals. Therefore, a name must be defined when creating a new measurement session.

16. SPECTRA ANALYSIS

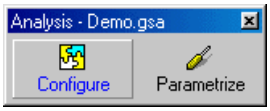
This chapter deals with spectra analysis (off-line analysis of audio records).

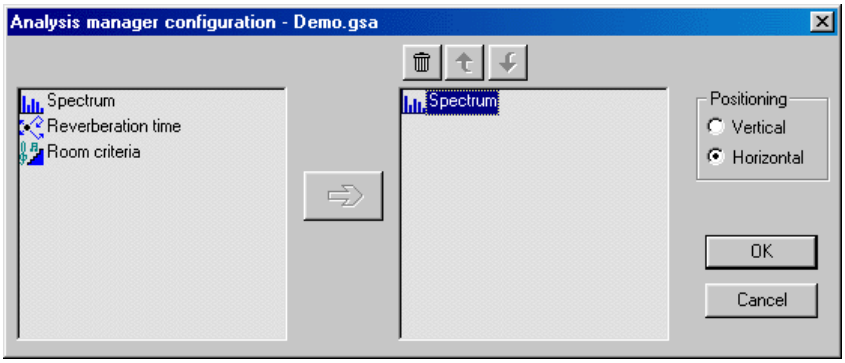
This mode allows the user to perform a batch analysis of existing audio signals stored in a measurement session datafile (as acquired with **dBBATI32**) to obtain spectra in octaves or third octaves.

The audio items to analyse are selected in a measurement session datafile. To analyse several audio items successively and in an automatic manner, use the **batch** command.

This chapter presents in a general manner how to set-up and perform spectra analysis.

Use the command **Analysis / New** to open a new analysis manager. This manager is used to select which analysis will be performed and to configure the analysis parameters of each one of them.

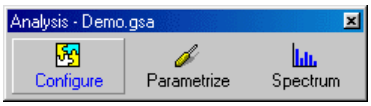




Click on **Configure** to select which elements will be added to the manager.

In this chapter, we select the type of element **Spectrum**.

The manager toolbar then looks like this:



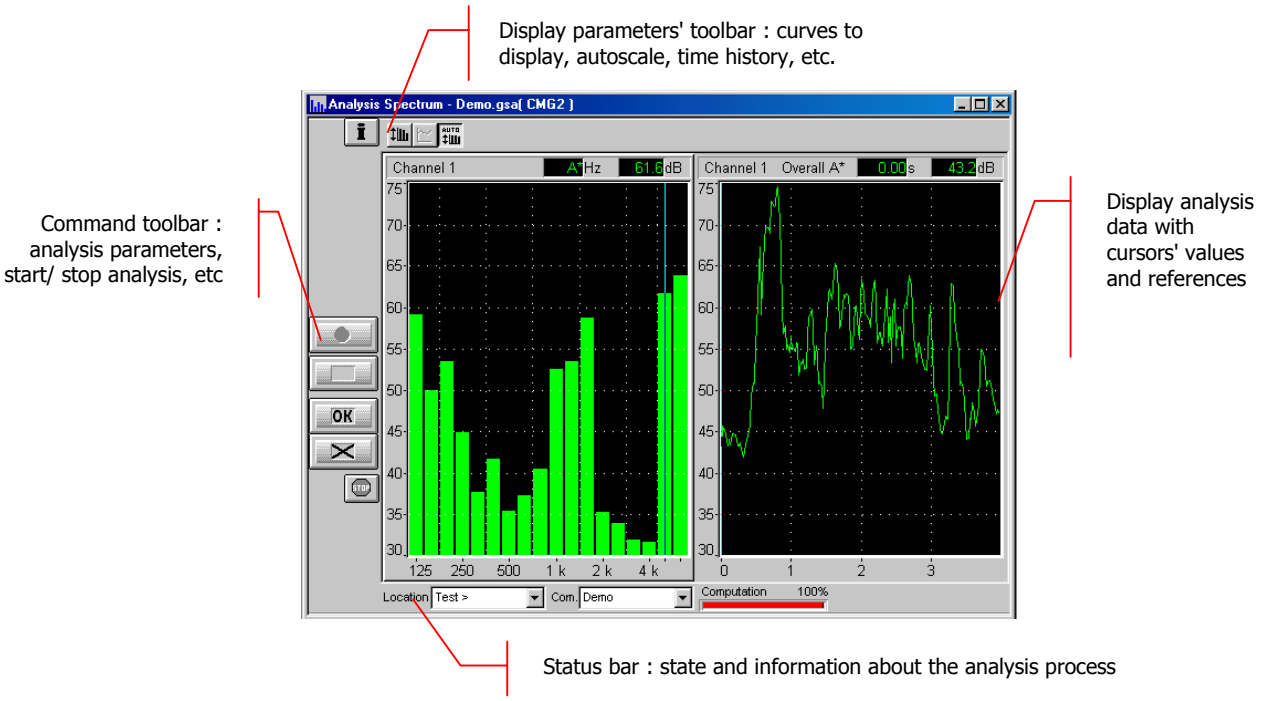
*Refer to **chapter 6** for more information on how to use the managers in **dBBATI32**.*

All the display and analysis parameters can be saved in an analysis manager file (*.GSA) by using the command **Analysis / Save As**.

16.1. Analysis window overview

Use the icon

Spectrum of the analysis manager to start the analysis window.


Display parameters' toolbar : curves to display, autoscale, time history, etc.
Command toolbar : analysis parameters, start/ stop analysis, etc
Display analysis data with cursors' values and references
Status bar : state and information about the analysis process
Analysis Spectrum - Demo.gsa(CMG2)
Channel 1
Channel 1 Overall A*
OK
Location
Test >
Com.
Demo
Computation
100%

The analysis configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

Show/hide information table

Start analysis

Stop the analysis in progress

Validate current results and store them in a measurement session datafile

Cancel current results and start again

The following icons are displayed if averaging conditions are set at the analysis parameters' stage (See **paragraph 16.2.2**).

Store the current averaged spectra in a measurement session datafile

End analysis process in batch mode

Save results in a measurement session datafile

The display type and the display parameters of the active curves are controlled using the **horizontal toolbar**:

Automatic re-scaling of the display

Enable or disable display of the time history plot and select the frequency band to monitor

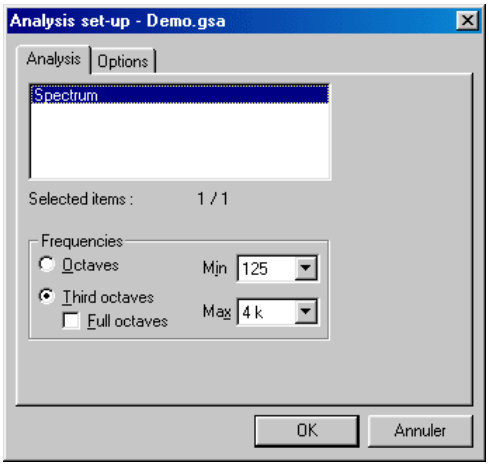
Perform an automatic autoscale to adjust data display at the end of the analysis.

16.2. Analysis set-up

Analysis set-up can be done by pressing the key **Parametrize** of the manager.

📖 *Refer to **chapter 6** for more information on how to use the managers.*

16.2.1.Analysis parameters

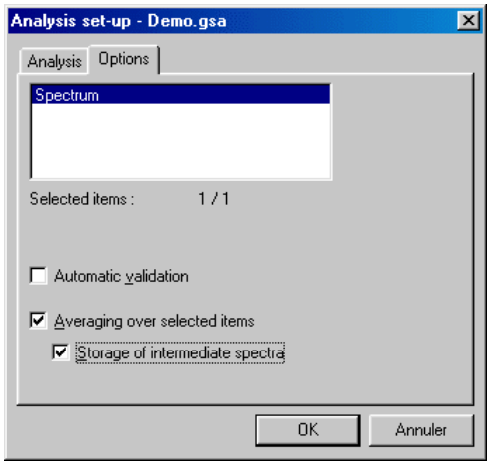


Use the **analysis** tab of the analysis set-up dialog box.

Choose between octave and third octave spectrum analysis and define the frequency limits for the analysis.

16.2.2.Averaging and processing options

Use the **options** tab of the analysis set-up dialog box.



- **Automatic validation** of the results. When a spectrum is calculated, it will be automatically stored in the active data session.
  This option is useful for a batch analysis of several audio data items (see **paragraph 16.4**).

- **Averaging over all the selected data items.**

In this case, **dBBATI32** will calculate the mean spectrum for all the selected audio items. The intermediate spectra associated with each item may also be saved.

📖 *Refer to **paragraph 16.5** for more information on the analysis process*

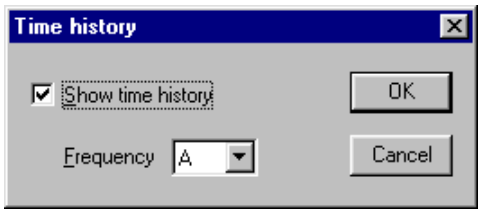
16.3. Display set-up and status bar

16.3.1.Dynamic settings

The horizontal toolbar can be used to set the graphical display parameters of the analysis window.

Use the command **Display / Autoscale** to automatically re-scale the plots as a function of the computed noise levels.

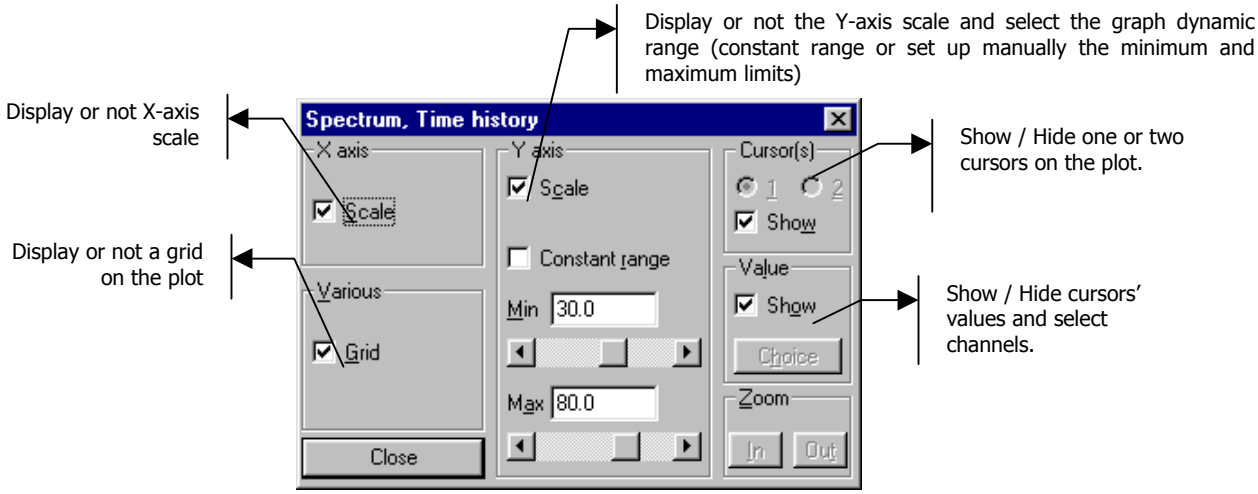
Use the command **Display / Automatic autoscale at the end of acquisition** to automatically re-scale the plots at the end of the analysis process.



Use the command **Display / Time history** to display the time history plot and select the frequency band to monitor. The following dialog box appears on-screen.

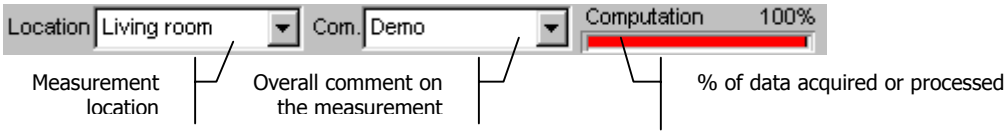
Tick the box **Show time history** and select the **frequency** band (or overall level) to display.

Use the command **Display / Set-up** to define the display parameters of each type of data (spectra and time histories) in the measurement window. The following dialog box is displayed on screen.



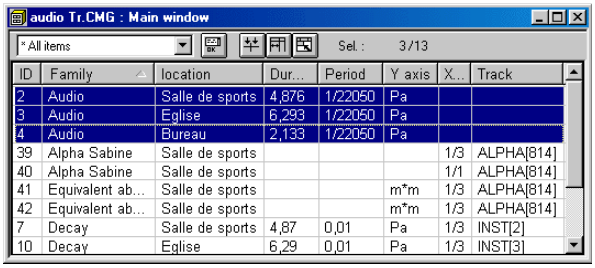
16.3.2.Status bar

The status bar allows the operator to select the measurement locations and input a general comment, either by direct input or by selection in a list, corresponding to the last 4 locations completed by the operators and the default locations.



By default, the location and the comment correspond to the audio data item being analysed.

16.4. Selection of audio records to analyse



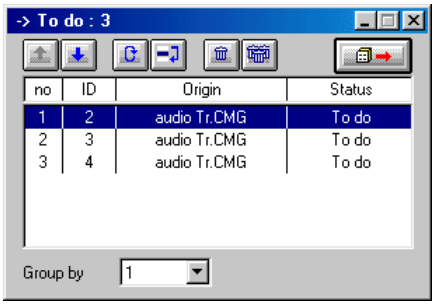
ID	Family	location	Dur...	Period	Y axis	X...	Track
2	Audio	Salle de sports	4,876	1/22050	Pa		
3	Audio	Eglise	6,293	1/22050	Pa		
4	Audio	Bureau	2,133	1/22050	Pa		
39	Alpha Sabine	Salle de sports				1/3	ALPHA[814]
40	Alpha Sabine	Salle de sports				1/1	ALPHA[814]
41	Equivalent ab...	Salle de sports			m*m	1/3	ALPHA[814]
42	Equivalent ab...	Salle de sports			m*m	1/3	ALPHA[814]
7	Decay	Salle de sports	4,87	0,01	Pa	1/3	INST[2]
10	Decay	Eglise	6,29	0,01	Pa	1/3	INST[3]

Select the audio records to analyse in a measurement session data file.

- **Analyse one audio record** → Start the analysis process (see **paragraph 16.5**)
- **Analyse several audio records** → Use the **batch** command explained below.

To analyse several audio records successively and automatically, use the batch mode.

Use the command **Datafile / Batch** to display the batch window shown aside.



no	ID	Origin	Status
1	2	audio Tr.CMG	To do
2	3	audio Tr.CMG	To do
3	4	audio Tr.CMG	To do

Use the icon of the batch window to import the audio items selected in the measurement session datafile to the batch window.

The following icons of the batch window may be used :

Use these icons to select in which order the items will be analysed

Use this icon to reset the batch analysis. All items are in the state "**To do** ".

Processing for the selected item is "**Not active**").

Remove the selected item from the batch analysis

Remove all items from the batch analysis

"Group by" : For spectral analysis of existing audio items, this element must be set to 1 because the analysis is done sequentially, one item after another.

The main information bar of the analysis window shows the indication «**Batch**», as well as the number of items analysed and the total number of items to be analysed.

Start the analysis process (see **paragraph 16.5**).

16.5. Analysis process

After configuration, the user can control the analysis process with the following icons:

Start the analysis. (F3)
The analysis starts according to the defined analysis and averaging parameters. If no audio record has been selected in the measurement session datafile, this key is greyed.
Analysis is performed for :
- Either a single audio record selected in the session datafile (the main information bar of the analysis window indicate the name of the session datafile)
- Either for a set of audio records defined in the batch window (the main information bar of the analysis window indicates Batch)

Stop the analysis in progress (F4)

Stop the analysis process in batch mode

Accept current results (F7)
The analysis results are saved in a measurement session datafile.

The following icons are displayed if averaging conditions are set (see **paragraph 16.2.2**).

Store the current averaged spectra in a measurement session datafile.

Do not accept current results and restart the analysis (F6)

Save results in a measurement session datafile.

17. REVERBERATION TIME (RT) ANALYSIS

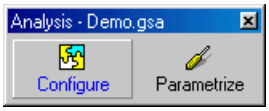
This chapter deals with RT spectra analysis (off-line analysis of audio records).

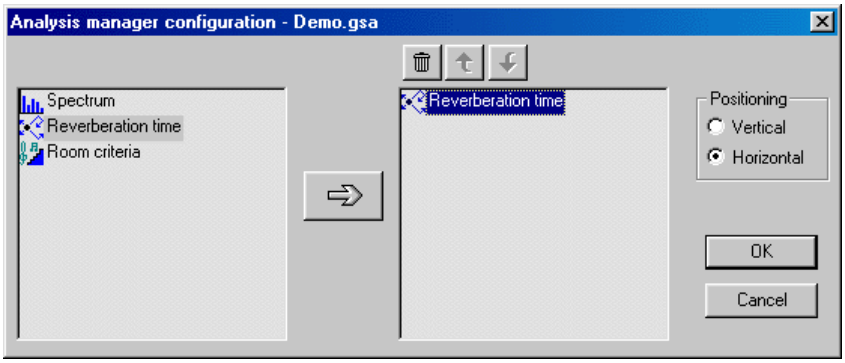
This mode allows the user to perform a batch analysis of existing audio signals stored in a measurement session datafile (as acquired with **dBBATI32**) to obtain reverberation time spectra and time decays in octaves or third octaves.

The audio items to analyse are selected in a measurement session datafile. To analyse several audio items successively and in an automatic manner, use the **batch** command.

This chapter presents how to set-up and perform RT spectra analysis.

Use the command **Analysis / New** to open a new analysis manager. This manager is used to select which analysis will be performed and to configure the analysis parameters of each one of them.

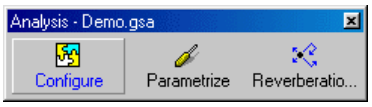




Click on **Configure** to select which elements will be added to the manager.

In this chapter, we select the type of element **Reverberation time**.

The manager toolbar then looks like this:



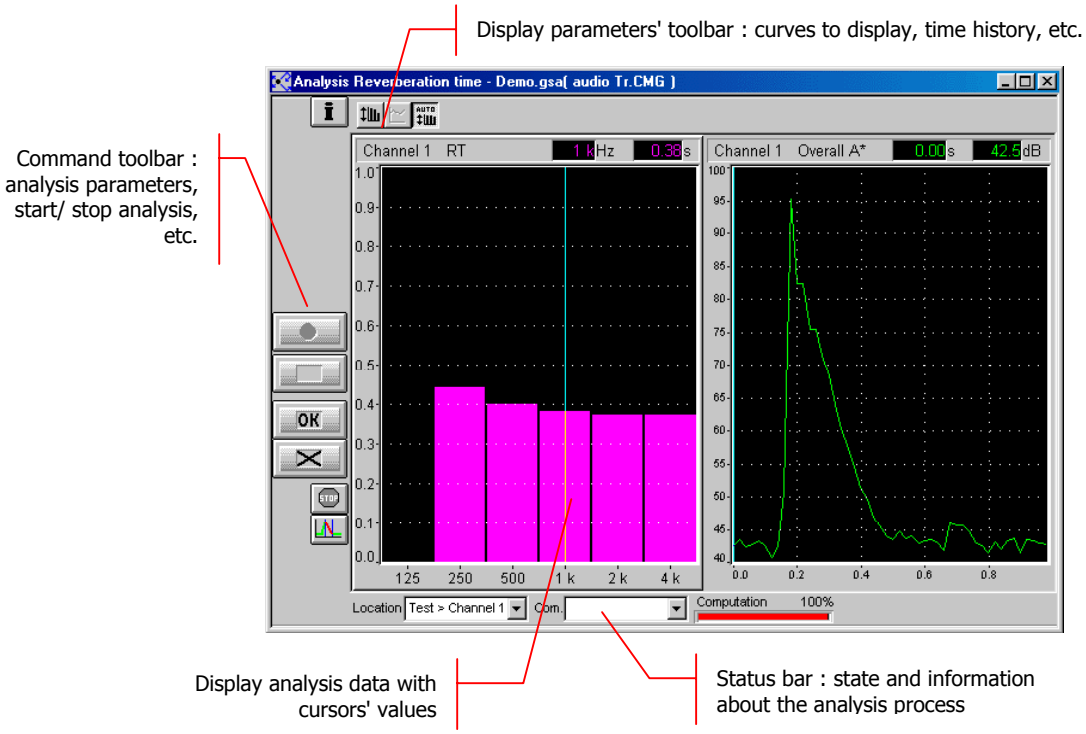
*Refer to **chapter 6** for more information on how to use the managers in **dBBATI32**.*

All the display and analysis parameters can be saved in an analysis manager file (*.GSA) by using the command **Analysis / Save As.**

17.1. Analysis window overview

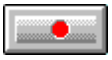
Use the icon

Reverberation time of the analysis manager to start the RT analysis window.



The analysis configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

Show/hide information table


Start analysis

Stop the analysis in progress

Validate current results and store them in a measurement session datafile

Cancel current results and start again

Display the time decay edition window for RT spectrum calculation (See **chapter 10**).

The following icons are displayed if averaging conditions are set at the analysis parameters' stage (See **paragraph 17.2.3**).

Store the current averaged spectra in a measurement session datafile

End analysis process in batch mode

Save results in a measurement session datafile

The display type and the display parameters of the active curves are controlled using the **horizontal toolbar**:

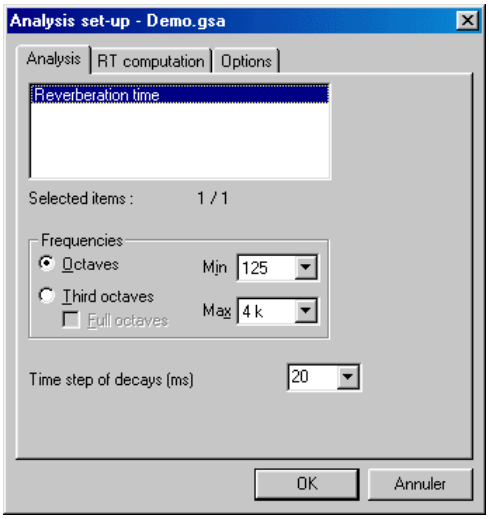
Automatic re-scaling of the display

Enable or disable display of the time history plot and select the frequency band to monitor

Perform an automatic autoscale to adjust data display at the end of the analysis.

17.2. Analysis set-up

Analysis set-up can be done by pressing the key **Parametrize** of the manager.



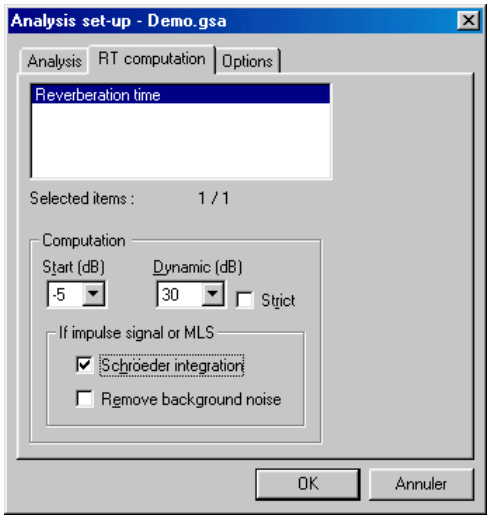
17.2.1. Analysis parameters

Use the **analysis** tab of the analysis set-up dialog box.

Choose between octave and third octave spectrum analysis and define the frequency limits for the analysis.

Also, define the time basis used in the computation of the reverberation time decay. Greater accuracy is achieved with a smaller time basis, though at the expense of calculation time.

17.2.2. RT computation parameters



Click on the **Parametrize** key of the measurement manager and select the **RT computation** tab.

dBBATI32 offers reverberation time calculations from either stationary, impulsive or MLS signals.

The computation algorithm therefore depends upon the type of the audio records to analyse. Refer to **paragraph 15.2.6.5**.

From an impulsive signal source (using MLS or not), it is possible to apply integration (Schröeder) and/or suppress the background noise.

During the calculation phase, the start and end settings define the regression boundaries that are used to calculate the RT values by frequency bands.

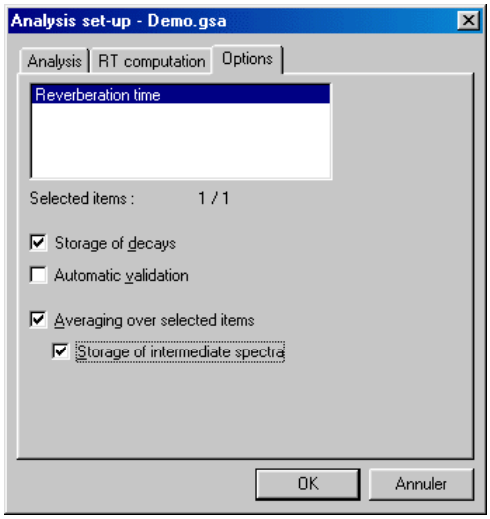
📖 *See **chapter 21.2** for a detailed reverberation time calculation explanation.*

17.2.3. Processing and averaging parameters

Use the **options** tab of the analysis set-up dialog box.

- **Store the time decays** associated with each RT spectrum, for later analysis.
- **Automatic validation** of the results. When a spectrum is calculated, it will be automatically stored in the active data session. This option is useful for a batch analysis of several audio data items (see **paragraph 17.4**).
- **Averaging over all the selected data items.** In this case, **dBBATI32** will calculate the mean RT spectrum for all the selected audio items. The intermediate spectra associated with each item may also be saved.

📖 *Refer to **paragraph 17.5** for more information on the analysis process*



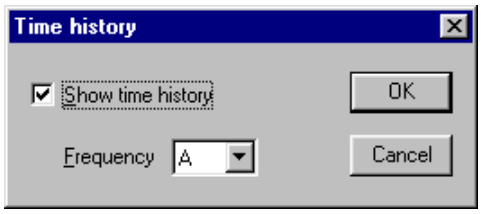
17.3. Display set-up and status bar

17.3.1.Dynamic settings

The horizontal toolbar can be used to set the graphical display parameters of the RT analysis window.

Use the command **Display / Autoscale** to automatically re-scale the plots as a function of the computed noise levels.

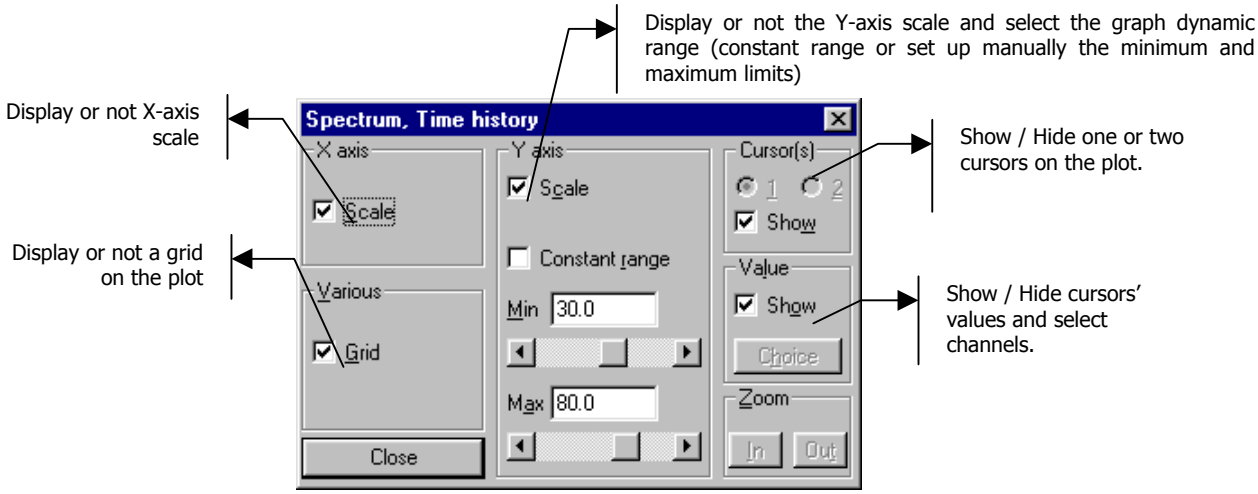
Use the command **Display / Automatic autoscale at the end of acquisition** to automatically re-scale the plots at the end of the analysis process.



Use the command **Display / Time history** to display the time history plot and select the frequency band to monitor. The following dialog box appears on-screen.

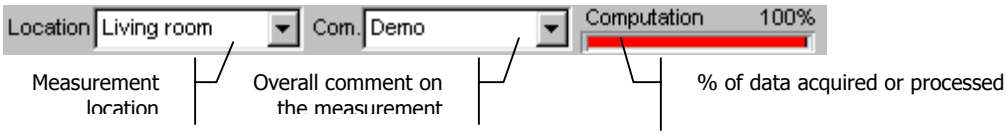
Tick the box **Show time history** and select the **frequency** band (or overall level) to display.

Use the command **Display / Set-up** to define the display parameters of each type of data (spectra and time histories) in the measurement window. The following dialog box is displayed on screen.



17.3.2.Status bar

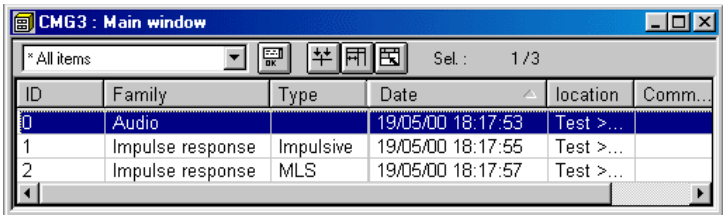
The status bar allows the operator to select the measurement locations and input a general comment, either by direct input or by selection in a list, corresponding to the last 4 locations completed by the operators and the default locations.



By default, the location and the comment correspond to the audio data item being analysed.

17.4. Selection of records to analyse

Select the audio records to analyse in a measurement session data file.



Example of measurement session that contains the three types of items compatible with RT analysis.

The following items may be used for RT analysis :

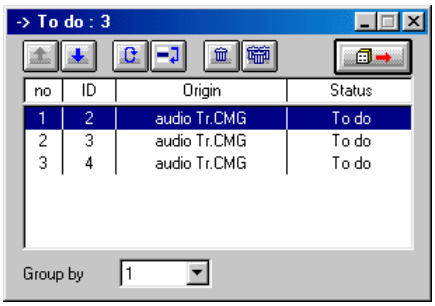
- audio
- impulse response
- MLS impulse response

From an impulsive signal source (or MLS signal), it is possible to apply integration (Schröeder) and/or suppress the background noise.

- **Analyse one audio record** → Start the analysis process (see **paragraph 17.5**)
- **Analyse several audio records** → Use the **batch** command explained below

To analyse several items successively and automatically, use the batch mode.

Use the command **Datafile / Batch** to display the batch window shown aside.



Use the icon **of the batch window to import the items selected in the measurement session datafile to the batch window.**

The following icons of the batch window may be used :

Use these icons to select in which order the items will be analysed

Use this icon to reset the batch analysis. All items are in the state "**To do** ".

Processing for the selected item is "**Not active**").

Remove the selected item from the batch analysis

Remove all items from the batch analysis

Group by" : For spectral analysis of existing items, this element must be set to 1 because the analysis is done sequentially, one item after another.

The main information bar of the analysis window shows the indication «**Batch**», as well as the number of items analysed and the total number of items to be analysed

Start the analysis process (see **paragraph 17.5**)

17.5. Analysis process

After configuration, the user can control the analysis process with the following icons:

Start the analysis. (F3)
The analysis starts according to the defined analysis and averaging parameters. If no record has been selected in the measurement session datafile, this key is greyed.
Analysis is performed for :

- Either a single audio record selected in the session datafile (the main information bar of the analysis window indicate the name of the session datafile)
- Either for a set of audio records defined in the batch window (the main information bar of the analysis window indicates Batch)

Stop the analysis in progress (F4)

Accept current results (F7)
The analysis results are saved in a measurement session datafile.

Do not accept current results and restart the analysis (F6)

Time decay edition (See **chapter 10**). Display the time decay adjustment window to adjust manually the decay 'slope in each frequency band, if the RT analysis results are not correct.

Stop the analysis process in batch mode**.**

The following icons are displayed if averaging conditions are set (see **paragraph 17.2.3**).

Store the current averaged spectra in a measurement session datafile.

Save results in a measurement session datafile.

18. ROOM CRITERIA ANALYSIS

This chapter deals with the analysis of room criteria from existing data items (off-line).
These criteria are obtained from echogram curves per frequency bands. These curves result from an analysis by digital filtering from an impulse response of the room. This response may be obtained by MLS technique.

dBBATI32 allows the user to compute the following room criteria :

- **Quality criteria :** TR, EDT, Clarity, Definition, ST1.
- **Intelligibility criteria :** STI, RASTI.

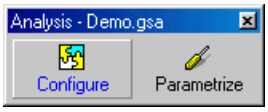
These criteria are obtained from echogram curves per frequency bands. These curves result from an analysis by digital filtering from an impulse response of the room. This response may be obtained by MLS technique.

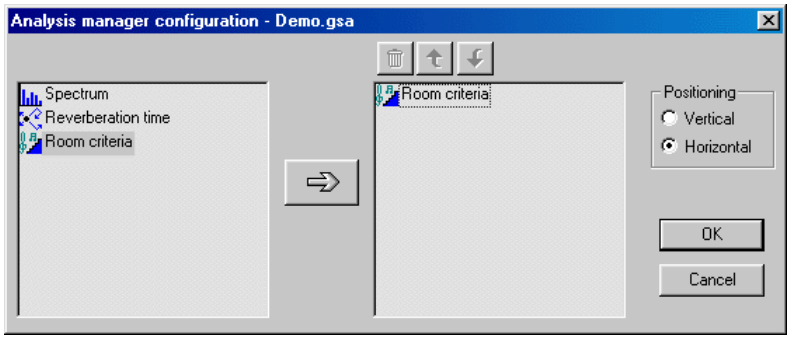
📖 *Refer to **chapter 21.5** for detailed explanations on the calculations, criteria definition and results' interpretation.*

The audio items to analyse are selected in a measurement session datafile. To analyse several audio items successively and in an automatic manner, use the **batch** command.

This chapter presents in a general manner how to set-up and perform room criteria analysis.

Use the command **Analysis / New** to open a new analysis manager. This manager is used to select which analysis will be performed and to configure the analysis parameters of each one of them.

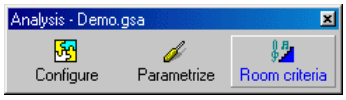




Click on **Configure** to select which elements will be added to the manager.

In this chapter, we select the type of element **Room criteria**.

The manager toolbar then looks like this:



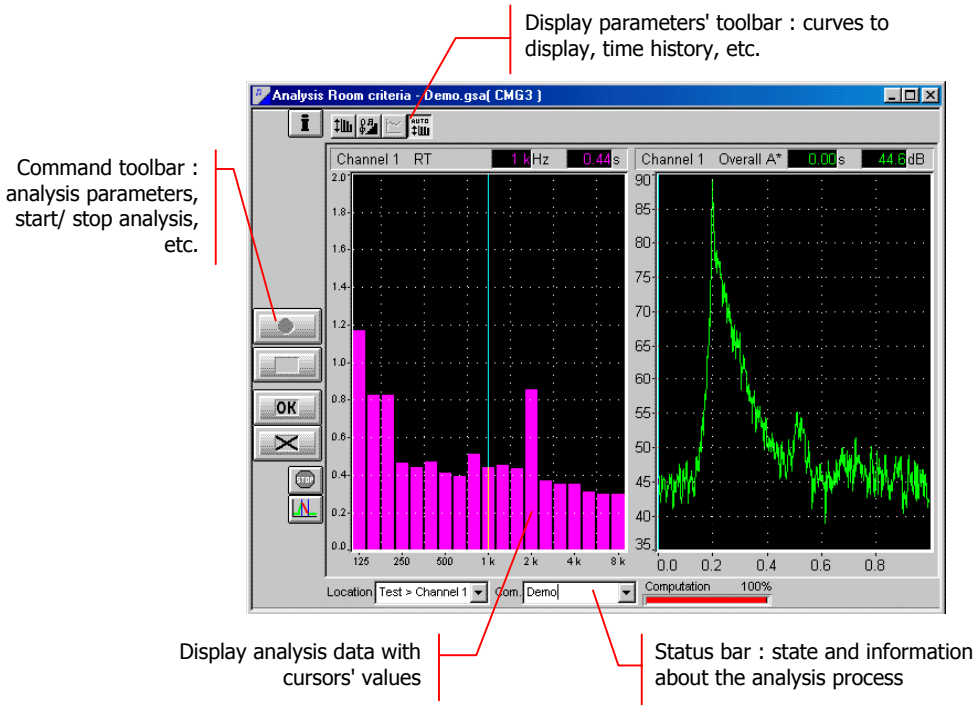
📖 *Refer to **chapter 6** for more information on how to use the managers in **dBBATI32**.*

All the display and analysis parameters can be saved in an analysis manager file (*.GSA) by using the command **Analysis / Save As**.

18.1. Analysis window overview

Use the icon

Room criteria of the analysis manager to start the room criteria analysis window.


Display parameters' toolbar : curves to display, time history, etc.
Command toolbar : analysis parameters, start/ stop analysis, etc.
Analysis Room criteria - Demo.gsa(CMG3)
Channel 1 RT
Channel 1 Overall A*
Location
Test > Channel 1
Com.
Demo
Computation
100%
Display analysis data with cursors' values
Status bar : state and information about the analysis process

The analysis configuration and control is accessible via the vertical **command toolbar**. In the following, we describe the functions of each icon:

Show/hide information table

Start analysis

Stop the analysis in progress

Validate current results and store them in a measurement session datafile

Cancel current results and start again

End analysis process in batch mode

Display the decay edition window (See **chapter 12**).

The display type and the display parameters of the active curves are controlled using the **horizontal toolbar**:

Automatic re-scaling of the display

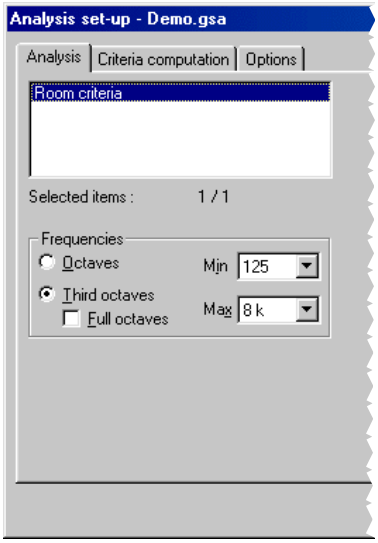
Select the room criterion to display in the spectrum view.

Enable or disable display of the time history plot and select the frequency band to monitor

Perform an automatic autoscale to adjust data display at the end of the analysis.

18.2. Analysis set-up

Analysis set-up can be done by pressing the key **Parametrize** of the manager.



18.2.1. Analysis parameters

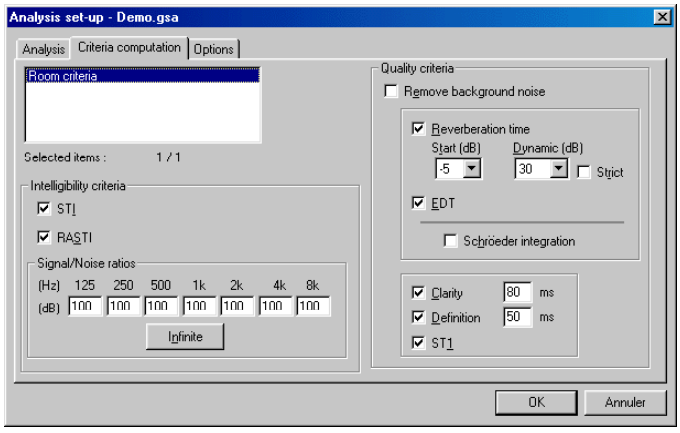
Use the **analysis** tab of the analysis set-up dialog box.

Choose between octave and third octave spectrum analysis and define the frequency limits for the analysis.

18.2.2. Criteria computation parameters

Click on the **Parametrize** key of the measurement manager and select the **Criteria computation** tab.

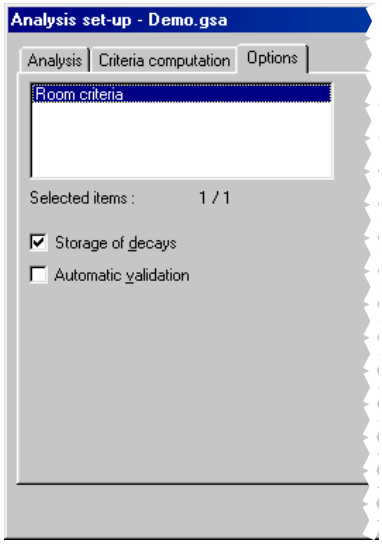
The computation of intelligibility criteria account for the signal to noise ratios per frequency bands. It is however to manually inputs these values.



By default, background noise is considered neglectable, thus having a signal to noise ratio infinite (100).

*Refer to **paragraph 21.5** for the calculation principle and definition of room criteria*

18.2.3. Analysis options



The configuration of measurement options can be performed in the **Options** tab of the analysis set-up dialog box.

- Define if **decays** are to be recorded into the measurement session, for later analysis.
- **Automatic validation** of the results.
  This option is useful for a batch analysis of several data items (see **paragraph 18.4**).

*Refer to **paragraph 18.5** for more information on the analysis process*

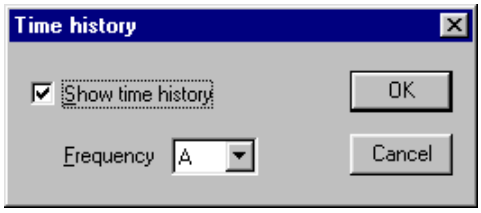
18.3. Display set-up and status bar

18.3.1.Dynamic settings

The horizontal toolbar can be used to set the graphical display parameters of the analysis window.

Use the command **Display / Autoscale** to automatically re-scale the plots as a function of the computed noise levels.

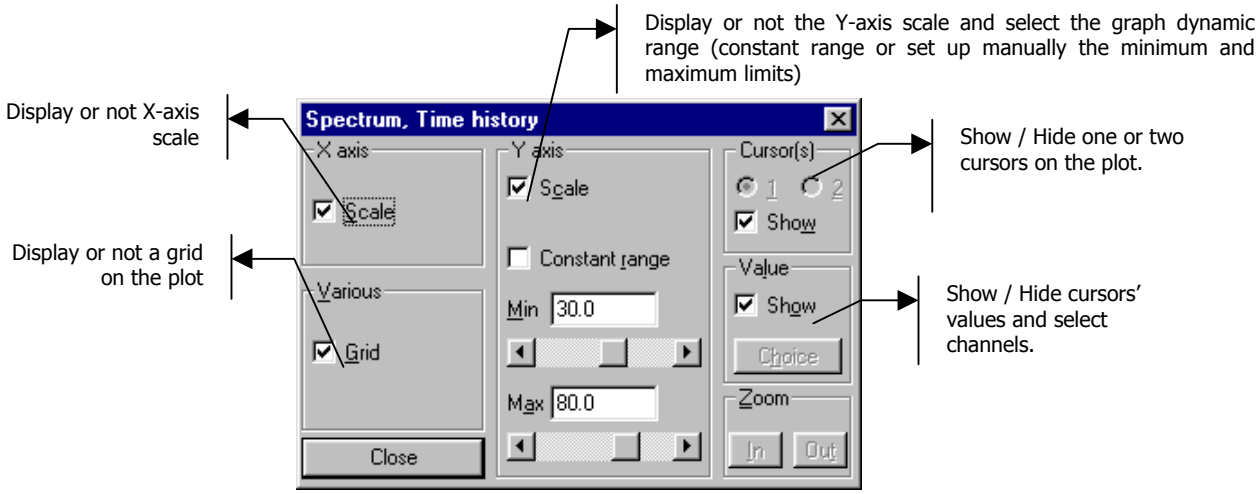
Use the command **Display / Automatic autoscale at the end of acquisition** to automatically re-scale the plots at the end of the analysis process



Use the command **Display / Time history** to display the time history plot and select the frequency band to monitor. The following dialog box appears on-screen.

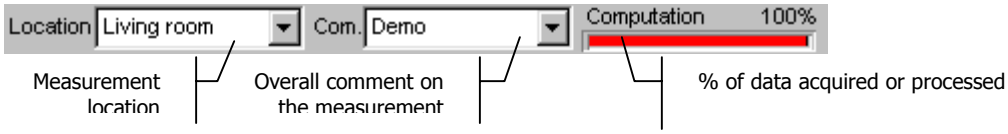
Tick the box **Show time history** and select the **frequency** band (or overall level) to display.

Use the command **Display / Set-up** to define the display parameters of each type of data (spectra and time histories) in the measurement window. The following dialog box is displayed on screen.



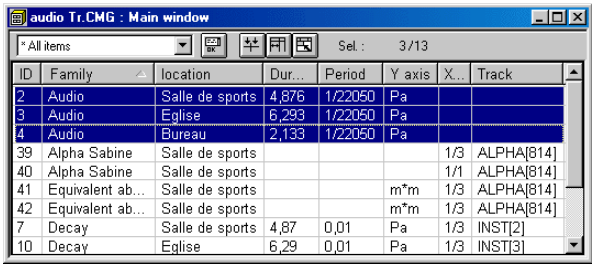
18.3.2.Status bar

The status bar allows the operator to select the measurement locations and input a general comment, either by direct input or by selection in a list, corresponding to the last 4 locations completed by the operators and the default locations.



By default, the location and the comment correspond to the audio data item being analysed.

18.4. Selection of records to analyse

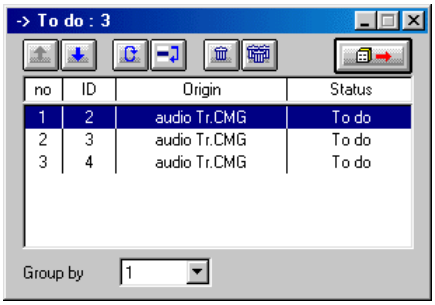

audio Tr.CMG : Main window
* All items
Sel. : 3/13
ID | Family | location | Dur... | Period | Y axis | X... | Track
2 | Audio | Salle de sports | 4,876 | 1/22050 | Pa
3 | Audio | Eglise | 6,293 | 1/22050 | Pa
4 | Audio | Bureau | 2,133 | 1/22050 | Pa
39 | Alpha Sabine | Salle de sports | 1/3 | ALPHA[814]
40 | Alpha Sabine | Salle de sports | 1/1 | ALPHA[814]
41 | Equivalent ab... | Salle de sports | m*m | 1/3 | ALPHA[814]
42 | Equivalent ab... | Salle de sports | m*m | 1/3 | ALPHA[814]
7 | Decay | Salle de sports | 4,87 | 0,01 | Pa | 1/3 | INST[2]
10 | Decay | Eglise | 6,29 | 0,01 | Pa | 1/3 | INST[3]

Select the audio records to analyse in a measurement session data file.

- **Analyse one record** → Start the analysis process (see **paragraph 18.5**)
- **Analyse several audio records** → Use the **batch** command explained below.

To analyse several items successively and automatically, use the batch mode.

Use the command **Datafile / Batch** to display the batch window shown aside.



Use the icon **of the batch window to import the items selected in the measurement session datafile to the batch window.**

The following icons of the batch window may be used :

Use these icons to select in which order the items will be analysed

Use this icon to reset the batch analysis. All items are in the state "**To do** ".

Processing for the selected item is "**Not active**").

Remove the selected item from the batch analysis

Remove all items from the batch analysis

Group by" : For spectral analysis of existing items, this element must be set to 1 because the analysis is done sequentially, one item after another.

The main information bar of the analysis window shows the indication «**Batch**», as well as the number of items analysed and the total number of items to be analysed

Start the analysis process (see **paragraph18.5**)

18.5. Analysis process

After configuration, the user can control the analysis process with the following icons:

Start the analysis. (F3)
The analysis starts according to the defined analysis parameters. If no record has been selected in the measurement session datafile, this key is greyed.
Analysis is performed for :
- Either a single record selected in the session datafile (the main information bar of the analysis window indicate the name of the session datafile)
- Either for a set of records defined in the batch window (the main information bar of the analysis window indicates Batch)

Stop the analysis in progress (F4)

Stop the analysis process in batch mode

Accept current results (F7)
The analysis results are saved in a measurement session datafile.

Decay edition (See **chapter 12**). Display the decay adjustment window to adjust manually the decay 'slope and direct wave arrival in each frequency band, if the analysis results are not correct

Do not accept current results and restart the analysis (F6)

19. STANDARD CALCULATIONS

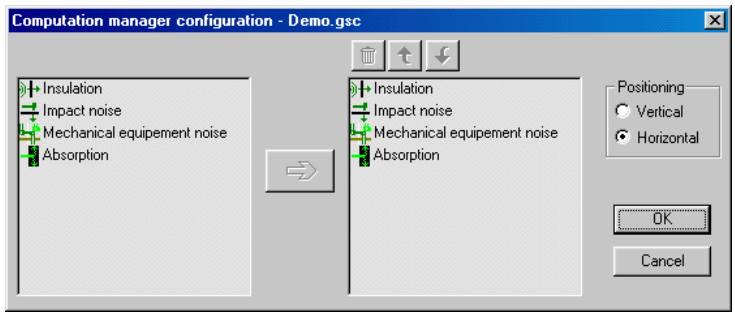
dBBATI32 can performed standard calculations from a variety of national and international standards.

This chapter presents the use and configuration of the following types of standard calculations : **Insulation, Impact noise, Mechanical equipment noise and sound absorption**.

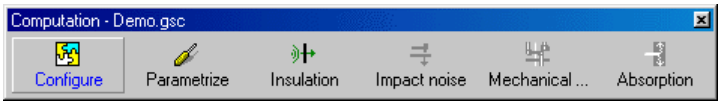
Use the command **Standard calculations / New** to open a new computation manager. This manager is used to select which calculations will be performed and to configure the calculation parameters of each one of them.

Click on **Configure** to select which elements will be added to the manager.

In this chapter, we select each type of standard calculations that can be done.



The manager toolbar then looks like this:

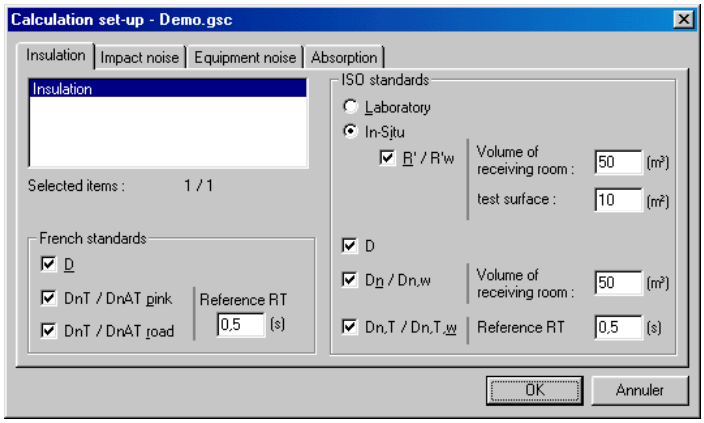


*Refer to **chapter 6** for more information on how to use the managers in **dBBATI32**.*

All the display and acquisition parameters can be saved in a measurement manager file (*.GSC) by using the command **Standard calculations / Save As**.

19.1. Computation parameters

Computation parameters can be accessed by pressing the key **Parametrize** of the manager. The dialog box shown below appears on screen :



Select from each tab the standard indices to compute.

For some calculations, it is possible to modify default computation parameters, such a reference RT value or room volumes.

When only one index is displayed, the result is a spectrum.

When two indices are displayed side by side, the result is a spectrum and the corresponding single value quantity.

Example : D : Raw sound insulation spectrum D
DnT / DnAT rose : Normalised insulation spectrum DnT and corresponding single number value DnTw.

Each criterion selected requires input data items in a measurement session datafile. The following tables give an overview of the criteria that can be computed, the corresponding standard, and the required data items for computation.

📖 ***Refer to chapter 21.4 for detailed explanations of the computation of each standard criteria.***

Insulation

			Input data items			
		Standard	Emitted noise spectrum	Received noise spectrum	RT spectrum	Background noise spectrum
Spectra	Raw level difference D	NF S 31-057	X	X		-
	Standardised level difference DnT		X	X	X	-
	Raw level difference D	ISO 140-4	X	X		-
	Normalised sound insulation Dn		X	X	X	-
	Standardised sound insulation Dn,T		X	X	X	-
	Sound reduction index R	ISO 140-3 (NFEN 140-3)	X	X	X	-
	Apparent sound reduction index R'	ISO 140-4 (NF EN 140-4)	X	X	X	-
Single values	A weighted standardised level difference DnAT	NF S 31-057	Spectrum DnT			
	Weighted normalised sound insulation Dn,w	ISO 717-1	Spectrum Dn			
	Weighted standardised sound insulation Dn,T,w		Spectrum Dn,T			
	Weighted sound reduction index Rw	ISO 717-1 (NF EN 717-1)	Spectrum R			
	Weighted apparent sound reduction index R'w		Spectrum R'			

Impact noise

			Input data items		
		Standard	Received impact noise spectrum	RT spectrum	Background noise spectrum
Spectra	Normalised impact sound pressure level LnT	NF S 31-057	X	X	-
	Normalised impact sound pressure level Ln	ISO 140-6 and ISO 140-7	X	X	-
	Normalised impact sound pressure level L'n		X	X	-
	Standardised impact sound pressure level L'nT		X	X	-
Single values	A-weighted normalised impact sound pressure level LnAT	NF S 31-057	Spectrum LnT		
	Weighted normalised impact sound pressure level Ln,w	ISO 717-2	Spectrum Ln		
	Weighted normalised impact sound pressure level L'n,w		Spectrum L'n		
	Weighted standardised impact sound pressure level L'nT,w		Spectrum L'nT,w		

Mechanical equipment noise

	Standard	**Input data items**
Normalised equipment noise level LeT	NF S 31-057	Equipment noise level (Leq) + RT spectrum

Absorption

	Standard	**Input data items**
Absorption coefficient αs	ISO 354 (NF EN 20354)	RT empty room + RT room with test specimen
Weighted sound absorption index αw	ISO 11654 (NF EN 11654)	Spectrum αs

***X** : compulsory* ***NF** : French standard*
***-** : optional* ***ISO** : international standard*

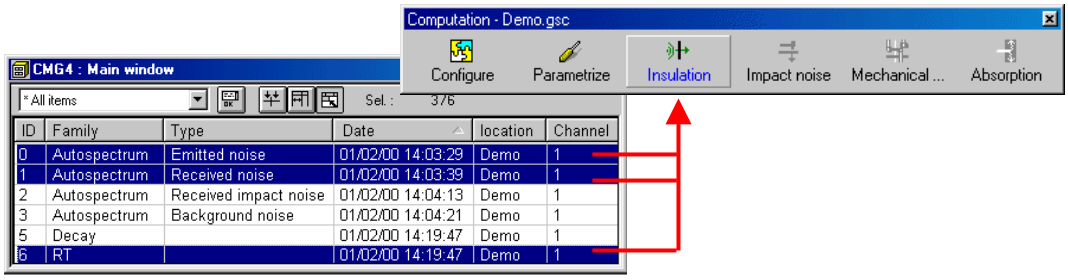
19.2. Computation process

19.2.1.Selection of the data items

❑ Simple calculations

Select the required data items to start a standard calculations. The icons of the computation manager are greyed until the adequate items have been selected in the measurement session datafile.

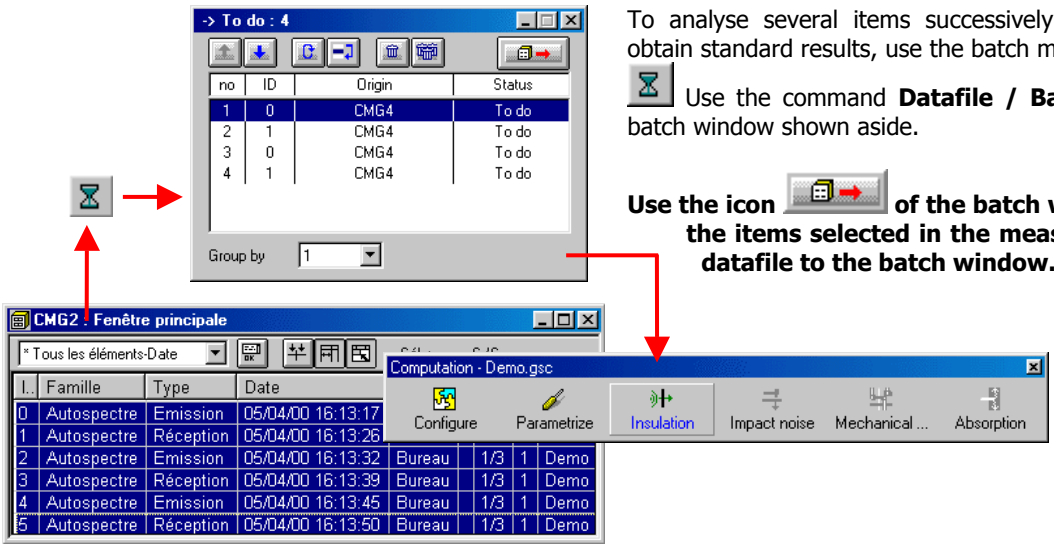
Example


Computation - Demo.gsc
Configure
Parametrize
Insulation
Impact noise
Mechanical ...
Absorption
CMG4 : Main window
* All items
Sel. : 376
ID | Family | Type | Date | location | Channel
0 | Autospectrum | Emitted noise | 01/02/00 14:03:29 | Demo | 1
1 | Autospectrum | Received noise | 01/02/00 14:03:39 | Demo | 1
2 | Autospectrum | Received impact noise | 01/02/00 14:04:13 | Demo | 1
3 | Autospectrum | Background noise | 01/02/00 14:04:21 | Demo | 1
5 | Decay | | 01/02/00 14:19:47 | Demo | 1
6 | RT | | 01/02/00 14:19:47 | Demo | 1

*When emission, reception and RT spectra are selected, the icon **Insulation** becomes active in the manager toolbar*

Warning ! For insulation calculations from spectra obtained using the MLS technique, two conditions must be fulfilled:
- All the spectra must have been obtained using the MLS technique.
- It is recommended that all spectra have the same response duration

❑ Batch processing


-> To do : 4
no | ID | Origin | Status
1 | 0 | CMG4 | To do
2 | 1 | CMG4 | To do
3 | 0 | CMG4 | To do
4 | 1 | CMG4 | To do
Group by 1
CMG2 : Fenêtre principale
* Tous les éléments-Date
I.. | Famille | Type | Date
0 | Autospectre | Emission | 05/04/00 16:13:17
1 | Autospectre | Réception | 05/04/00 16:13:26
2 | Autospectre | Emission | 05/04/00 16:13:32 | Bureau | 1/3 | 1 | Demo
3 | Autospectre | Réception | 05/04/00 16:13:39 | Bureau | 1/3 | 1 | Demo
4 | Autospectre | Emission | 05/04/00 16:13:45 | Bureau | 1/3 | 1 | Demo
5 | Autospectre | Réception | 05/04/00 16:13:50 | Bureau | 1/3 | 1 | Demo
Computation - Demo.gsc
Configure
Parametrize
Insulation
Impact noise
Mechanical ...
Absorption

To analyse several items successively and automatically obtain standard results, use the batch mode

Use the command **Datafile / Batch** to display the batch window shown aside.

Use the icon of the batch window to import the items selected in the measurement session datafile to the batch window..

The following icons of the batch window may be used :

Use these icons to select in which order the items will be analysed

Use this icon to reset the batch analysis. All items are in the state "**To do** ".

Processing for the selected item is "**Not active**").

Remove the selected item from the batch analysis

Remove all items from the batch analysis

"Group by" :Allows to create groups of items. For the above example, group items by 2 (emission and reception) for a batch processing of insulation criteria.

Start the computation process (see **paragraph 19.2.2**).

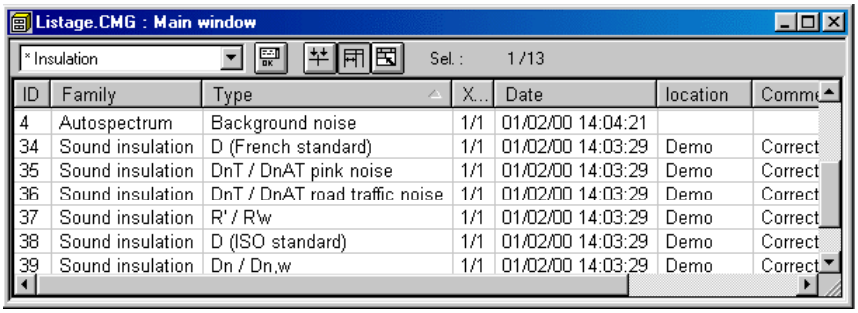
19.2.2.Run the computation

The computation process is started by clicking on the icons of the computation manager.

During computation, it is possible that some warning and confirmation dialog boxes are displayed. A message is displayed for example if the level difference between the received noise spectrum and the background noise spectrum, per frequency band, is too small.

Computation time may be long if many criteria have to be computed.

The results are then saved in the active measurement session data file. The added items may be identified using the values in the **Family** and **Type** columns. The **Comment** features any eventual warning that may have occurred during computation.


Listage.CMG : Main window
* Insulation
Sel. : 1 / 13
ID | Family | Type | X... | Date | location | Comme
4 | Autospectrum | Background noise | 1/1 | 01/02/00 14:04:21 | |
34 | Sound insulation | D (French standard) | 1/1 | 01/02/00 14:03:29 | Demo | Correct
35 | Sound insulation | DnT / DnAT pink noise | 1/1 | 01/02/00 14:03:29 | Demo | Correct
36 | Sound insulation | DnT / DnAT road traffic noise | 1/1 | 01/02/00 14:03:29 | Demo | Correct
37 | Sound insulation | R' / R'w | 1/1 | 01/02/00 14:03:29 | Demo | Correct
38 | Sound insulation | D (ISO standard) | 1/1 | 01/02/00 14:03:29 | Demo | Correct
39 | Sound insulation | Dn / Dn,w | 1/1 | 01/02/00 14:03:29 | Demo | Correct

📖 *Once the results are stored in the measurement session datafile, it is possible to edit, print and display the results (see **chapter 15**).*

📖 ***A test report may be automatically generated from these results. It may then be edited, printed and saved (see paragraph 15.5).***

20. SIMPLIFIED USER LEVEL

In standard mode, all the functions of the software are available. **It is possible to access to the simplified version of the software by using a command User level of the Preferences menu.**

20.1. Limitations

This version offers a simplified user interface to the operator, but some functions are not available.

- **One measurement channel only**

All types of measurements are available but they can only be performed with one active measurement channel. As a consequence, the type « Emi. / Rec. Simultaneously » is not available.

- **No analysis manager**

The analysis manager is not available in the simplified version. It is therefore not possible to obtain results by analysis of audio records.

- **No audio signal recording**

The signal recording mode (DAT recorder) is not available. Only measurement and standard calculations are available.

- **No importation of datafiles**

It is not possible to import datafiles such as 16bit 01dB files, WAV files or MP3 files into a measurement session datafile.

- **No room criteria**

Computation of room criteria is not available

- **No averaging**

It is not possible to average measurement results over several measurements, whatever the type of measurement selected.

- **Time step of the decays : fixed value**

The time step of the decays used for RT spectrum computation is fixed to 20 milliseconds.

- **Only one measurement or computation manager, saved automatically**

There is only one measurement manager and one computation manager in the simplified version. There contents cannot be modified, as all possible measurement or computations are displayed in the toolbars. Start a manager by simple click on an icon of the main toolbar.

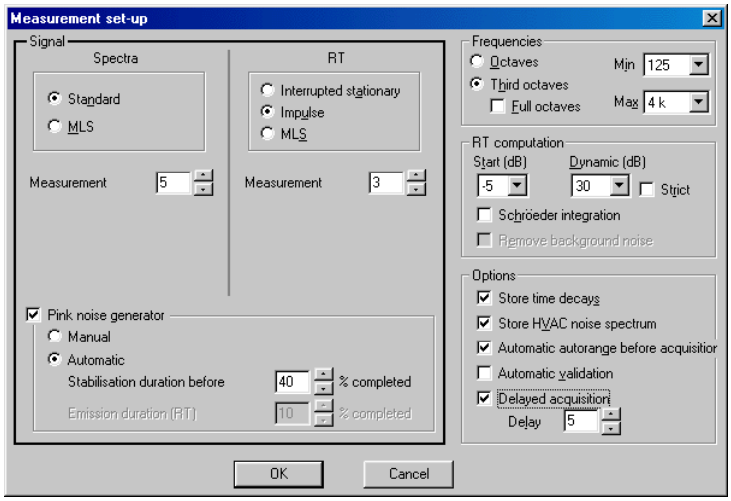
20.2. Measurement manager set-up (simplified version)

In simplified mode, the following measurements may be performed:

- Standard spectrum
- Emitted noise spectrum
- Received airborne noise spectrum
- Received impact noise spectrum
- Background noise spectrum
- Mechanical equipment noise spectrum
- Reverberation time spectrum

Measurement set-up can be done by pressing the key **Parametrize** of the manager. The dialog box shown below appears on screen :

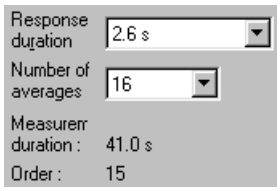
📖 ***Refer to the corresponding chapters in standard mode for more detailed explanations on how to configure and perform measurements in dBBATI32.***



- **Impulse and standard signal :** The measurement duration is defined in seconds.
- **MLS signal :** The **response duration** should be carefully selected, as it should be adapted to the geometry of the room.

  Make sure that the response duration is long enough in order to obtain a background noise at the end of the measurement.

  It is possible to **average** this response in order to decrease the effect of background noise. The higher the average number, the better the response quality, because the influence of random phenomena (background noise) decreases. On the other hand, the acquisition duration increases (the signal to noise ratio increase by 3 dB when doubling the number of averages.



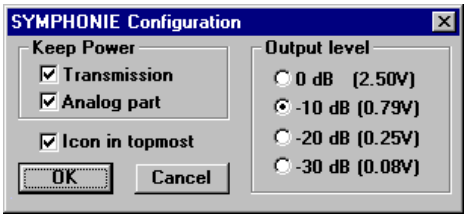
📖 ***Refer to annex 21.2 for more details on the MLS acquisition.***

- **General remark (SYMPHONIE)**

The output level of the signal can be set by the SYMPHONIE icon driver from the Windows task bar

Click on the icon

with the right of the mouse. A contextual menu appears. Choose the **Configuration** field and set the SYMPHONIE output level. The output level is changed in real time if you are playing a noise.



📖 *For more information on SYMPHONIE or HARMONIE (for example, connection plugs and driver configuration), consult the system installation manual.*

- **Noise generator parameters**

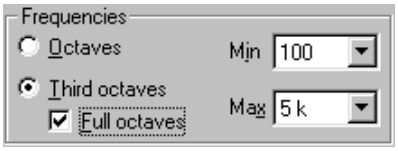
A pink noise generator may be used for measurement of emitted and received noise spectra as well as RT spectra.

It is necessary to connect an amplified loudspeaker to the LEMO4 output socket of the SYMPHONIE or HARMONIE acquisition box to generate a pink noise.

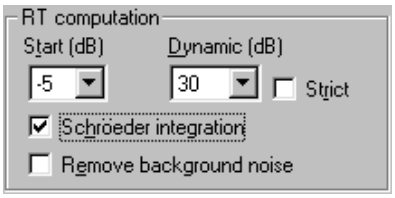
This generator may manually activated with an icon of the measurement window or the **F11** function key. It may also be automatically started and stopped by **dBBATI32.** To do so, tick the option **automatic** and define a **stabilisation duration** before staring the acquisition and the **emission duration**, as a function of the percentage of the complete duration of the measurement.

- **Frequencies**

Choose between octave and third octave spectrum analysis and define the frequency limits for the analysis.



- **RT computation**



dBBATI32 offers reverberation time calculations from either stationary, impulsive or MLS signals.

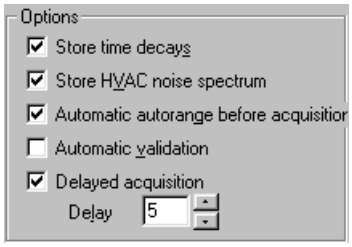
The computation algorithm therefore depends upon the type of measurements.

From an impulsive signal source (using MLS or not), it is possible to apply integration (Schröeder) and/or suppress the background noise.

During the calculation phase, the start and end settings define the regression boundaries that are used to calculate the RT values by frequency bands.

📖 *See **chapter 21.2** for a detailed reverberation time calculation explanation.*

- **Options**



Define if time **decays** are to be recorded into the measurement session, for later analysis.

Tick the box **Equipment noise spectrum storage** to save the mean Slow spectrum along with the measurement results (autospectrum data item).

Perform an **autorange** automatically before each measurement

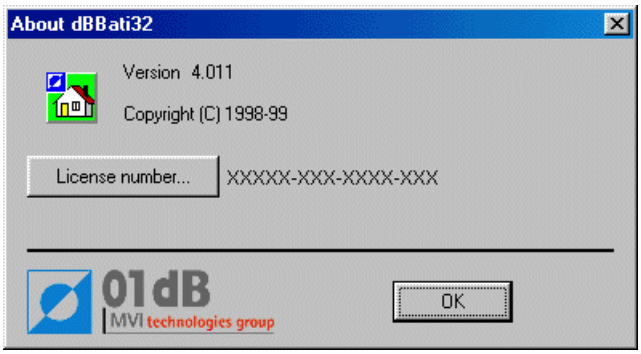
Automatic validation of the results.

Define a **delay** before starting a measurement (so that the operator may leave the room during the measurement process).

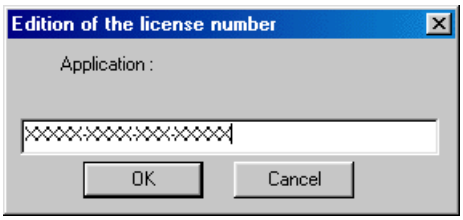
21. APPENDICES

21.1. Edition of the software licence number

Use this command (menu **? / About dBBATI32**) to obtain general information on the software version, copyright and licence number.



If the licence number of the software module has to be modified, click on the key Licence number. The following dialog box appears on screen:



Enter the new licence number, provided by 01dB technical support.

Start again the application software in order to account for this modification.

21.2. MLS technique

To measure an impulse response, most of use an impulse excitation such as a gun shot (with blank bullets). This method however is limited : non-linearity, insufficient dynamic, not repeatable, etc. It is the reason why an excitation with a stationary signal is preferred, as it offers a greater precision of the result, however, the measurement process and computation load could only be carried out on large computers with great computational power.

The MLS technique(**Maximum Length Sequence**) allows us to perform impulse response measurements that, once there are been filtered by frequency band, will give access to reverberation times and spectra (such as emitted and received noise spectra).

The Hadarmard transform (mathematical operation) is a great tool that can be used to obtain an impulse response from a stationary excitation in a simple and fast manner.

The emission of a white noise (binary pseudo-random sequence of maximum length) and the simultaneous measurement in a given point of a room will allow us to perform accurate frequency measurements, with great dynamic, in presence of extraneous noise sources. The MLS is therefore an efficient measurement technique in noisy environments that works without a powerful noise source and that allows to obtain results more accurate than traditional methods.

This technique is already implemented in various standard, such as for evaluation of noise barriers.

21.3. Reverberation time calculation algorithm

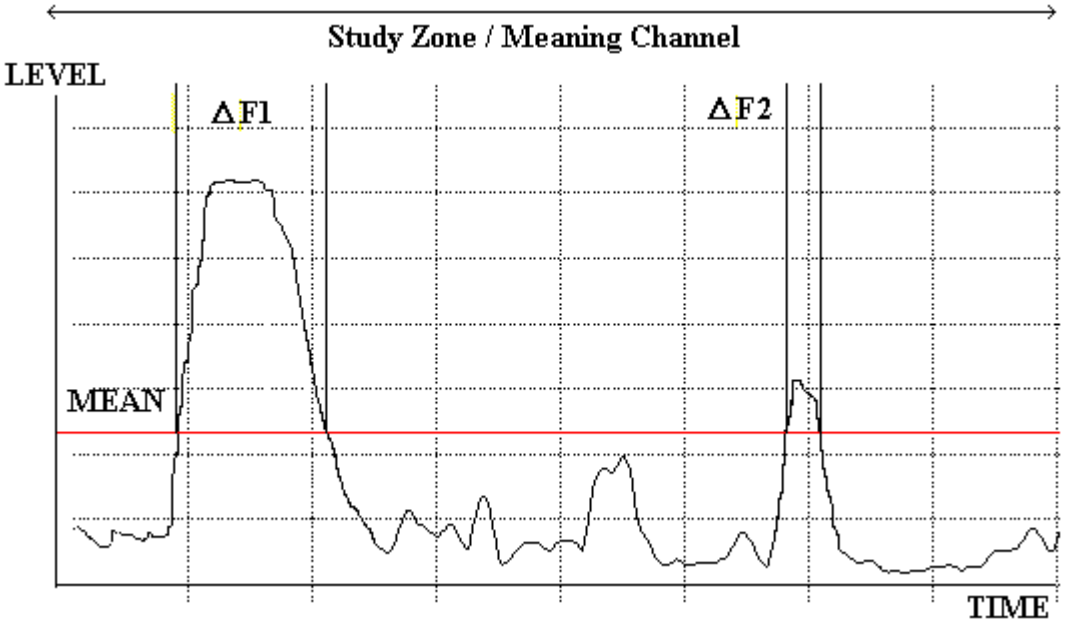
The reverberation time calculation is performed from the decay curves on each of the selected frequency bands. These decay curves are generated at the time of frequency analysis of the recorded signal.

The reverberation time calculation is divided into the following steps:

- **Determination of signal emergence and significant sequence**

Terminology

Reference band	The reference band is the medium frequency band of the considered frequency range i.e. when using the standardised 125 Hz to 4 kHz octave bands, the meaning channel is 500 Hz.
Study zone	The study zone is the time section of the decay taken into account for the RT computation. As default value, the study zone is the complete duration of the original signal file. It may be changed in order to improve the result using the observation window



This step is dedicated to identifying the section of the decay curve to be taken into account for the RT calculation. From the decay curve of the reference band, the program calculates the average level between the limits of the study zone. It checks the sequences of the decay curve where the level exceeds the average value and retains the largest value. This is the sequence on which the following computation will be performed. In the figure above the first sequence will be considered.

- **Determination of the pre-sequence noise (PRSN), sequence starting point (SSP) and sequence cut off point (SCOP).**

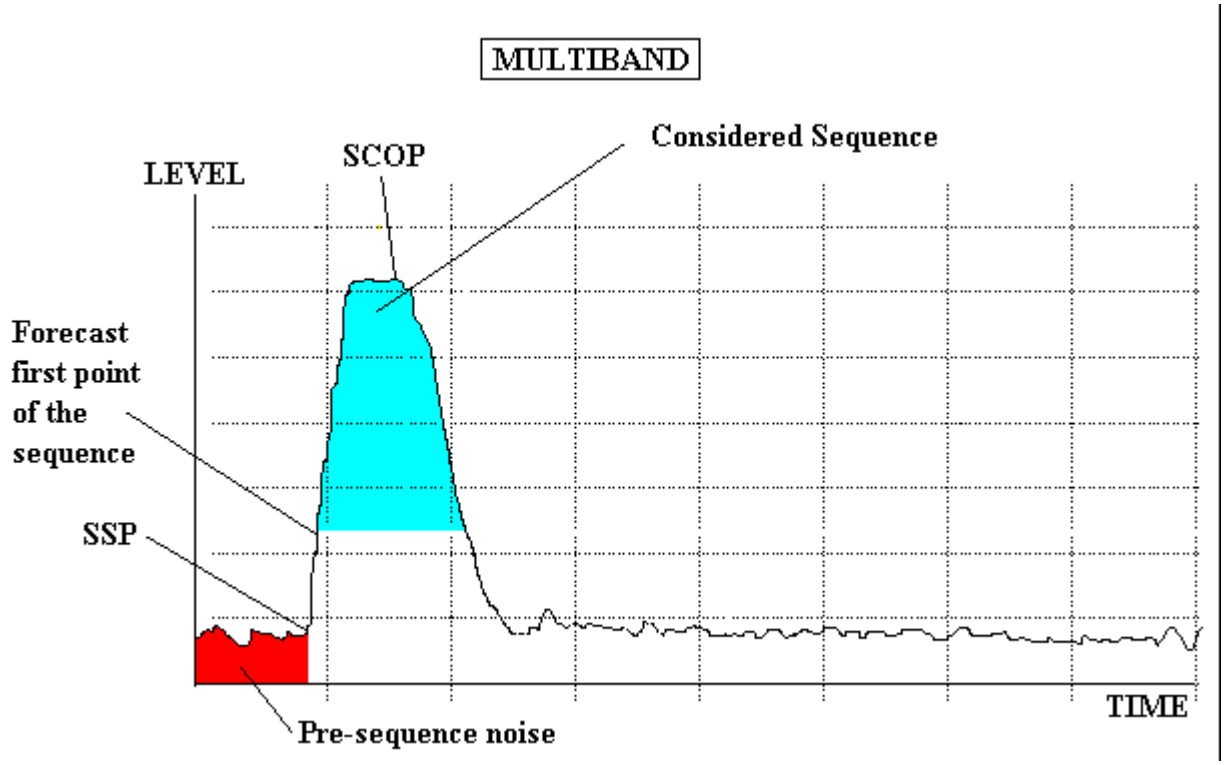
Terminology:

PRSN — The pre-sequence noise is the noise level prior to the source generation. The PRSN is frequency band independent

SSP — The sequence starting point is the point on the decay where the sequence starts. This point is defined in multi band mode. The SSP is frequency band independent

SCOP — The sequence cut off point is the point on the decay curve where the noise source has been interrupted. The SCOP is frequency band independent.

MULTI BAND — The multi band mode means that computation is performed taking into account all considered bands with particular weighting. The weighting consists in giving more importance to the high frequency bands than the low ones.

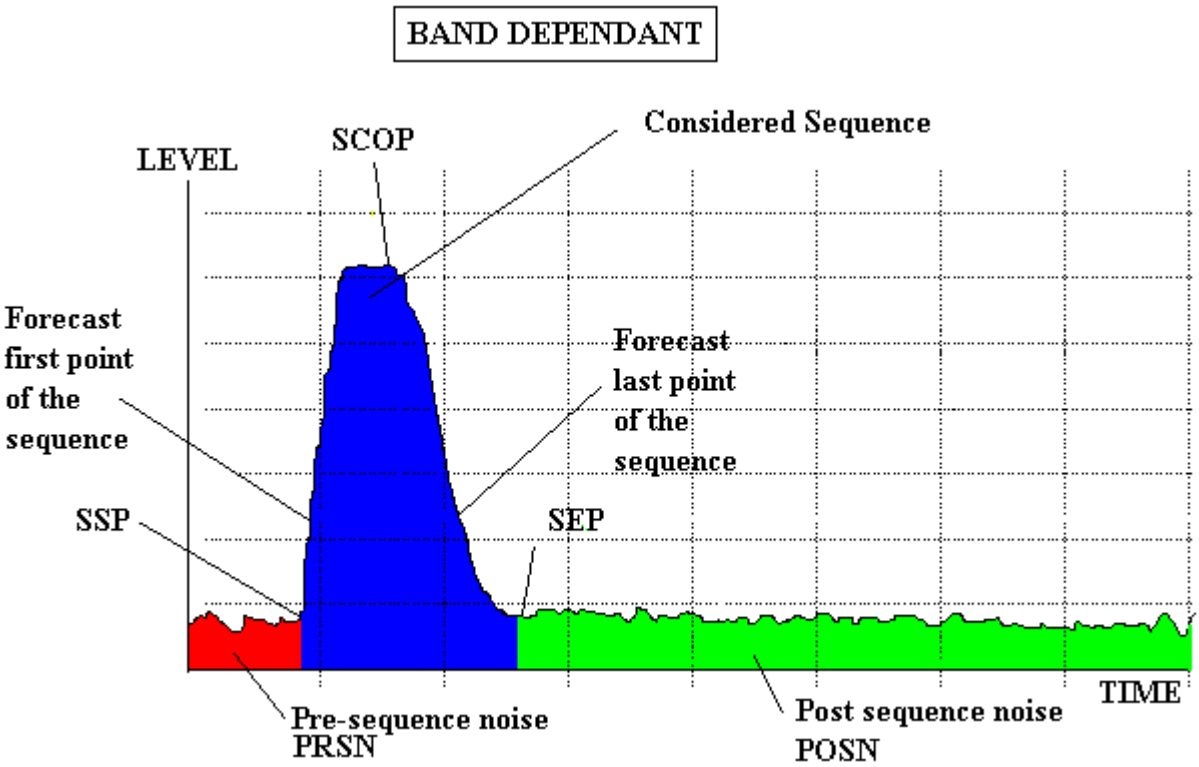


At this stage, the aim is to define the SSP and SCOP common to all decay curves. From the forecast first point of the sequence (see figure above), a recursive algorithm is applied to define the SSP. On the other hand, the determination of the SCOP point is performed. At the end of the process, the SSP and SCOP co-ordinates as well as the PRSN level are known.

- **Determination of the sequence ending point (SEP) and post-sequence noise (POSN) on each of the considered frequency bands.**

Terminology

SEP The sequence ending point is the point where the decay ends and the post-sequence noise starts. The SEP is frequency band dependent



POSN The post-sequence noise is the noise level once the decay itself has ended. The POSN is frequency band dependent.

For each of the considered frequency bands, this stage is dedicated to defining the SEP and the POSN. To do so, the same type of algorithm as during the SSP and PRSN determination is applied. Once completed, on each band, the limits on the decay curves to be taken into account for the reverberation time calculation are known.

Depending upon the RT calculation parameters, the integration as described by Schröeder and the POSN subtraction may be performed prior to calculating the RT values. When using a source cut-off noise, the next step is bypassed.

- **Applying integration (SCHRÖEDER theorem) and POSN subtraction when using an impulsive noise**

The 01dB program allows you to perform an integration (as defined by SCHRÖEDER in 1965) as well as POSN subtraction when using an impulsive noise.

As a matter of fact, the data measured from an impulsive noise represents the impulsive response of the room and should not be used directly to calculate the reverberation time.

When using the integration, it is also recommended that the POSN subtraction be performed in order to obtain reliable results.

The program allows you to perform the integration without POSN subtraction and in this case, the results are the user's responsibility

In 1965, SCHRÖEDER proved the identity between the square of the impulsive response of a room and the average of the decay curves due to a source cut off.

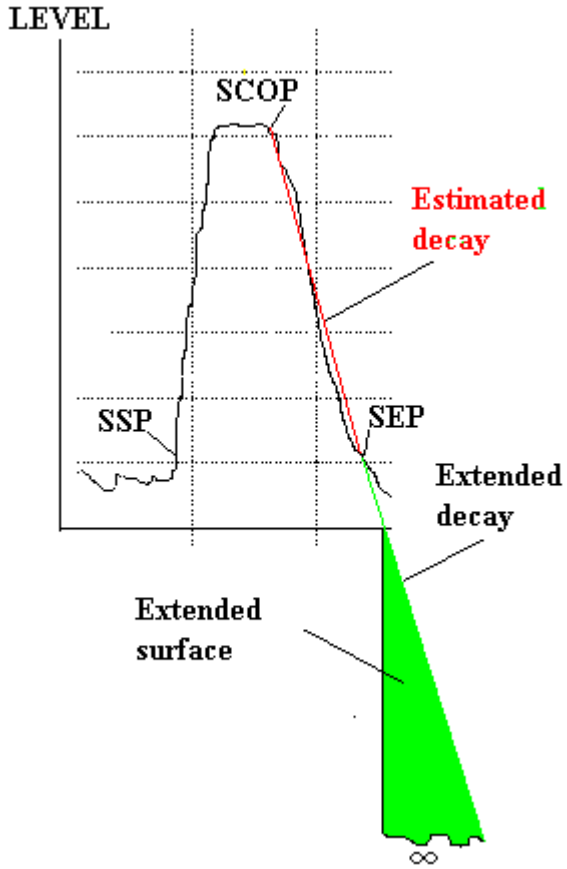
It is expressed by the following formula : $\langle S_d^2(t) \rangle = N * \int_0^\infty r^2(x)dx$

where :
S2(t) the mean sound intensity of the decay at t
r(t) the impulsive response

t = 0 is the source cut-off
N represents the source sound power

As the integral has to be calculated to the infinite according to the formula, it is not possible to perform a reliable RT calculation without using the POSN subtraction as the recording is finite.

The figure below shows the principle of the integration using the POSN subtraction**.**



An estimated decay curve is defined using a linear regression between the SCOP and SEP points.

This decay curve is extended to infinity. Therefore, the integration between the SCOP point and infinity is possible as the surface of the triangle (extended surface) is known.

At the end of the process, the reliable decay curves are completely defined and the RT determination is applied.

- **Reverberation time calculation according to the user defined parameters.**

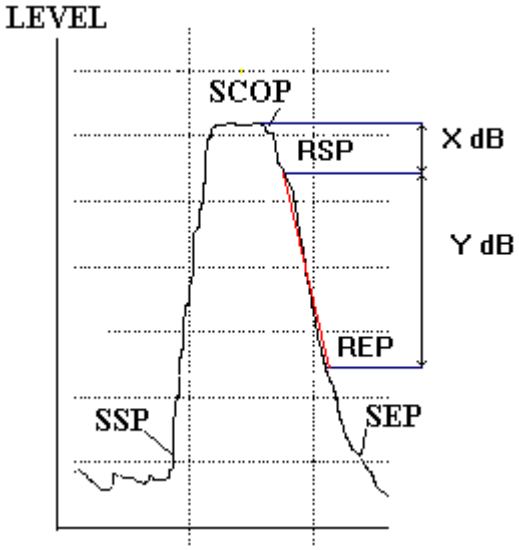
User defined parameters

X : Start (dB) — Defines the regression starting point (RSP) on the decay curve to be considered for the linear regression calculation. The RSP point is defined as being the point on the decay which is X decibels below the level of the SCOP. The RSP point is frequency dependent.

Y : Dynamic (dB) — Defines the regression ending point (REP). The REP point is defined as being the point on the decay curve which is Y decibels below the RSP point. The REP point is frequency dependent.

Strict — The strict option disables the calculation on the band where it is not possible to define the REP point i.e. if the decays dynamic range is lower than Y -X. In this case, the RT value for the corresponding band is not calculated.

The figure below shows the principle of the RT value calculation



The Reverberation time for the corresponding frequency band is calculated as being the slope of the linear regression between the RSP and REP.

In the case where the REP cannot be calculated (below the SEP), when using the strict option, the RT is not calculated whereas when disabling it, the RT is calculated between the RSP and the SEP.

Once the RT is calculated, the program displays the correlation between the linear regression and the points of the decay curve. The RT computation process is ended.

21.4. Standard calculations

21.4.1.Insulation

French standard	Raw level difference D	Standardised level difference DnT	A weighted standardised level difference DnAT (with reference to Pink noise or Road traffic noise)
Standard	NF S 31-057	NF S 31-057	NF S 31-057
Inputs	- 1 emitted noise spectrum - 1 received noise spectrum - Optionally, 1 background noise spectrum	- 1 emitted noise spectrum - 1 received noise spectrum - 1 RT spectrum - Optionally, 1 background noise spectrum	- 1 Standardised level difference spectrum DnT
Parameters		Reference RT value	
Frequencies	- Octaves or third octaves	- Octaves or third octaves	- Octaves or third octaves - The DnT spectrum must comprise all frequency bands in the range 100 - 5000 Hz in third octaves, or 125 - 4000 Hz in octaves
Computation	Per frequency band : D = L1 – L2 (dB) L1 : Emitted noise level L2 : Received noise level If background noise spectrum as an input, there is an additional correction. (cf (1))	Per frequency band : DnT = D + 10 lg (T / T0) (dB) T : RT reception room T0 : Reference RT value The lower limit of the T duration is 0.4 s. If the measured value is less than this limit, T=0.4s for the calculation. If background noise spectrum as an input, there is an additional correction. (cf (1))	Calculation for the frequency bands in the range 100 - 5000 Hz in third octaves, or 125 - 4000 Hz in octaves j : indice of the frequency band m : 6 for octaves measurements 18 for third octaves measurements Sj : Level for the frequency band j of the reference emitted noise spectrum for which the calculation is made (pink noise or road traffic noise) (Cf Table 1) Cj : A weighting value for the frequency band j (Cf Table 2) DnTj : Value of the standardised level difference for the frequency band j A weighted overall level of the theoretical emitted noise spectrum : $XE = 10\lg\left(\sum_{j=1}^{m} 10^{(Sj+Cj)/10}\right)$ A weighted overall level of the theoretical received noise spectrum : $XR = 10\lg\left(\sum_{j=1}^{m} 10^{(Sj-DnTj+Cj)/10}\right)$ **DnAT = XE – XR (in dBA)**
Limitations	Cf background noise correction (1)	Cf background noise correction (1)	
Result	Result per octave or third octave bands, over the whole frequency of the input spectra quantities D	Result per octave or third octave bands, over the whole frequency of the input spectra quantities DnT	Single number value in dBA DnAT (pink noise or road traffic noise according to the reference used)

ISO standards	Sound reduction index R	Weighted sound reduction index Rw	Apparent sound reduction index R'	Weighted apparent sound reduction index R'w
Standard	ISO 140-3 (NF EN 140-3)	ISO 717-1 (NF EN 717-1)	ISO 140-4 (NF EN 140-4)	ISO 717-1 (NF EN 717-1)
Inputs	- 1 emitted noise spectrum - 1 received noise spectrum - 1 RT spectrum - Optionally, 1 background noise spectrum	- 1 sound reduction index spectrum R	- 1 emitted noise spectrum - 1 received noise spectrum - 1 RT spectrum - Optionally, 1 background noise spectrum	- 1 apparent sound reduction index spectrum R’
Parameters	- V : Volume of reception room (m^3) - S : Area of the test specimen equal to the test opening (m^2)		- V : Volume of reception room (m^3) - S : Area of the test specimen equal to the test opening (m^2)	
Frequencies	- Third octaves	- Third octaves - The sound reduction index spectrum R must contain the frequency bands ranging from100 to 3150 Hz	- Octaves or third octaves	- Octaves or third octaves - The apparent sound reduction index spectrum R’ must contain the frequency bands ranging from100 to 3150 Hz in third octaves and 125 - 2000 Hz in octaves
Computation	Equivalent absorption area A per frequency band: $A = (0.16 * V) / T$ (m^2) V : Volume of reception room (m^3) T : RT reception room Sound reduction index per frequency band : $R = L_1 – L_2 + 10 \lg(S/A)$ (dB) L_1 : Emitted noise spectrum L_2 : Received noise spectrum S : Test area If background noise spectrum as an input, there is an additional correction. (Cf (2))	Computation is carried out taking into account the frequency bands ranging from 100 to 3150 Hz The reference curve (cf table 3) is shifted in steps of 1 dB towards the measured curve (R spectrum) until the sum of the unfavourable deviations is as large as possible but no more than 32.0 dB (2.0 dB per frequency band – 16 bands) An unfavourable deviation at a particular frequency occurs when the result of measurements is greater than the reference value. Only the unfavourable deviations are taken into account. The max. unfavourable deviation at any frequency should be recorded if it exceeds 8.0 dB. After the progressive curve shifting, R_w (dB) is the value of the reference curve at 500 Hz.	Equivalent absorption area A per frequency band: $A = (0.16 * V) / T$ (m^2) V : Volume of reception room (m^3) T : RT reception room Apparent sound reduction index per frequency band : $R' = L_1 – L_2 + 10 \lg(S/A)$ (dB) L_1 : Emitted noise spectrum L_2 : Received noise spectrum S : Test area If background noise spectrum as an input, there is an additional correction. (Cf (3))	Computation is carried out taking into account the frequency bands ranging from 100 to 3150 Hz in third octaves and 125 - 2000 Hz in octaves. The reference curve (cf table 3) is shifted in steps of 1 dB towards the measured curve (R’ spectrum) until the sum of the unfavourable deviations is as large as possible but no more than 32.0 dB (2.0 dB per frequency band – 16 bands) in third octaves and 10.0 dB (2.0 dB per frequency band – 5 bands) in octaves. An unfavourable deviation at a particular frequency occurs when the result of measurements is greater than the reference value. Only the unfavourable deviations are taken into account. The max. unfavourable deviation at any frequency should be recorded if it exceeds 8.0 dB After the progressive curve shifting, R'_w (dB) is the value of the reference curve at 500 Hz.
Limitations				
Result	Result per third octave bands, over the whole frequency of the input spectra quantities R	Single number value in dB R_w	Result per octave or third octave bands, over the whole frequency of the input spectra quantities R’	Single number value in dB R'_w

ISO standards	Raw level difference D	Normalised sound insulation Dn	Weighted normalised sound insulation Dn,w	Standardised sound insulation Dn,T	Weighted standardised sound insulation Dn,T,w
Standard	ISO 140-4	ISO 140-4	ISO 717-1	ISO 140-4	ISO 717-1
Inputs	- 1 emitted noise spectrum - 1 received noise spectrum - Optionally, 1 background noise spectrum	- 1 emitted noise spectrum - 1 received noise spectrum - 1 RT spectrum - Optionally, 1 background noise spectrum	- 1 Normalised sound insulation spectrum Dn	- 1 emitted noise spectrum - 1 received noise spectrum - 1 RT spectrum - Optionally, 1 background noise spectrum	- 1 standardised sound insulation spectrum Dn,T
Parameters		- V : Volume of reception room (m^3)		Reference RT	
Frequencies	- Octaves or third octaves	- Octaves or third octaves	- Octaves or third octaves - The Dn spectrum must contain the frequency bands ranging from100 to 3150 Hz in third octaves and 125 - 2000 Hz in octaves	- Octaves or third octaves	- Octaves or third octaves - The DnT spectrum must contain the frequency bands ranging from100 to 3150 Hz in third octaves and 125 - 2000 Hz in octaves
Computation	Per frequency band : $D = L1 - L2$ (dB) L1 : Emitted noise level L2 : Received noise level If background noise spectrum as an input, there is an additional correction. (cf (3))	Per frequency band : $D_n = D - 10 \lg (0.16*V / T*A_0)$ (dB) V : Volume of reception room (m^3) T : RT reception room A_0 : Reference equivalent absorption area (10 m²) If background noise spectrum as an input, there is an additional correction. (cf (3))	Computation is carried out taking into account the frequency bands ranging from 100 to 3150 Hz in third octaves and 125 - 2000 Hz in octaves. The reference curve (cf table 3) is shifted in steps of 1 dB towards the measured curve (Dn spectrum) until the sum of the unfavourable deviations is as large as possible but no more than 32.0 dB (2.0 dB per frequency band – 16 bands) in third octaves and 10.0 dB (2.0 dB per frequency band – 5 bands) in octaves. An unfavourable deviation at a particular frequency occurs when the result of measurements is greater than the reference value. Only the unfavourable deviations are taken into account. The max. unfavourable deviation at any frequency should be recorded if it exceeds 8.0 dB After the progressive curve shifting, $D_{n,w}$ (dB) is the value of the reference curve at 500 Hz.	Per frequency band : $D_{n,T} = D + 10 \lg (T / T_0)$ (dB) T : RT reception room T0 : Reference RT value If background noise spectrum as an input, there is an additional correction. (cf (3))	Computation is carried out taking into account the frequency bands ranging from 100 to 3150 Hz in third octaves and 125 - 2000 Hz in octaves. The reference curve (cf table 3) is shifted in steps of 1 dB towards the measured curve (DnT spectrum) until the sum of the unfavourable deviations is as large as possible but no more than 32.0 dB (2.0 dB per frequency band – 16 bands) in third octaves and 10.0 dB (2.0 dB per frequency band – 5 bands) in octaves. An unfavourable deviation at a particular frequency occurs when the result of measurements is greater than the reference value. Only the unfavourable deviations are taken into account. The max. unfavourable deviation at any frequency should be recorded if it exceeds 8.0 dB After the progressive curve shifting, $D_{n,T,w}$ (dB) is the value of the reference curve at 500 Hz.
Result	Result per octave or third octave bands, over the whole frequency of the input spectra quantities D	Result per octave or third octave bands, over the whole frequency of the input spectra quantities D_n	Single number value in dB $D_{n,w}$	Result per octave or third octave bands, over the whole frequency of the input spectra quantities $D_{n,T}$	Single number value in dB $D_{n,T,w}$

21.4.2.Impact noise

French standard	Normalised impact sound pressure level LnT	A-weighted normalised impact sound pressure level LnAT
Standard	NF S 31-057	NF S 31-057
Inputs	- 1 received impact noise spectrum (received noise level of test floor excited by a standardised tapping machine). - 1 RT spectrum - Optionally, 1 background noise spectrum	- 1 normalised impact sound pressure level LnT
Parameters	Reference RT value	
Frequencies	- Octaves or third octaves	- Octaves or third octaves - The L_{nT} spectrum must contain the frequency bands ranging from100 to 5000 Hz in third octaves and 125 - 4000 Hz in octaves
Computation	Per frequency band : $L_{nT} = L_i - 10 \lg (T / T_0)$ (dB) L_i :Received impact noise (raw impact noise level) T : RT reception room T0 : Reference RT value The lower limit of the T duration is 0.4 s. If the measured value is less than this limit, T=0.4s for the calculation. If background noise spectrum as an input, there is an additional correction. (cf (1))	Computation is carried out taking into account the frequency bands ranging from 100 to 5000 Hz in third octaves and 125 - 4000 Hz in octaves. j : indice of the frequency band m : 6 for octaves measurements 18 for third octaves measurements Cj : A weighting value for the frequency band j (Cf Table 2) LnTj : Value of the normalised impact sound pressure level for the frequency band j $L_{nAT} = 10 \lg \left(\sum_{j=1}^{m} 10^{(LnTj + Cj)/10} \right)$ (in dBA)
Limitations	Cf background noise correction (1)	
Result	Result per octave or third octave bands, over the whole frequency of the input spectra quantities L_{nT}	Single number value in dBA L_{nAT}

ISO standard	Normalised impact sound pressure level Ln	Weighted normalised impact sound pressure level Ln,w	Normalised impact sound pressure level L'n
Standard	ISO 140-6	ISO 717-2	ISO 140-7
Inputs	- 1 received impact noise spectrum (received noise level of test floor excited by a standardised tapping machine). - 1 RT spectrum - Optionally, 1 background noise spectrum	1 Normalised impact sound pressure level Ln spectrum	- 1 received impact noise spectrum (received noise level of test floor excited by a standardised tapping machine). - 1 RT spectrum - Optionally, 1 background noise spectrum
Parameters	- V : Volume of reception room (m^3)		- V : Volume of reception room (m^3)
Frequencies	- Third octaves	- Third octaves - The Ln spectrum must contain the frequency bands ranging from100 to 3150 Hz in third octaves	- Octaves or third octaves
Computation	Per frequency band : $L_n = L_i + 10 \lg (0.16*V / T*A_0)$ (dB) L_i :Received impact noise (raw impact noise level) V : Volume of reception room (m^3) T : RT reception room A_0 : Reference equivalent absorption area (10 m²) If background noise spectrum as an input, there is an additional correction. (cf (2))	Computation is carried out taking into account the frequency bands ranging from 100 to 3150 Hz in third octaves The reference curve (cf table 4) is shifted in steps of 1 dB towards the measured curve (Ln spectrum) until the sum of the unfavourable deviations is as large as possible but no more than 32.0 dB (2.0 dB per frequency band – 16 bands) An unfavourable deviation at a particular frequency occurs when the result of measurements is greater than the reference value. Only the unfavourable deviations are taken into account. After the progressive curve shifting, $L_{n,w}$ (dB) is the value of the reference curve at 500 Hz.	Per frequency band : $L_n = L_i + 10 \lg (0.16*V / T*A_0)$ (dB) L_i :Received impact noise (raw impact noise level) V : Volume of reception room (m^3) T : RT reception room A_0 : Reference equivalent absorption area (10 m²) If background noise spectrum as an input, there is an additional correction. (cf (3))
Result	Result per third octave bands, over the whole frequency of the input spectra quantities L_n	Single number value in dB $L_{n,w}$	Result per octave or third octave bands, over the whole frequency of the input spectra quantities L'_n

ISO standard	Weighted normalised impact sound pressure level L'n,w	Standardised impact sound pressure level L'nT	Weighted standardised impact sound pressure level L'nT,w
Standard	ISO 717-2	ISO 140-7	ISO 717-2
Inputs	- 1 normalised impact sound pressure level L'n spectrum	- 1 received impact noise spectrum (received noise level of test floor excited by a standardised tapping machine). - 1 RT spectrum - Optionally, 1 background noise spectrum	- 1 standardised impact sound pressure level L'nT spectrum
Parameters		Reference RT	
Frequencies	- Octaves or third octaves - The L'n spectrum must contain the frequency bands ranging from100 to 3150 Hz in third octaves or 125 - 2000 Hz in octaves	- Octaves or third octaves	- Octaves or third octaves - The L'nT spectrum must contain the frequency bands ranging from100 to 3150 Hz in third octaves or 125 - 2000 Hz in octaves
Computation	Computation is carried out taking into account the frequency bands ranging from 100 to 3150 Hz in third octaves and 125 - 2000 Hz in octaves. The reference curve (cf table 4) is shifted in steps of 1 dB towards the measured curve (L'n spectrum) until the sum of the unfavourable deviations is as large as possible but no more than 32.0 dB (2.0 dB per frequency band – 16 bands) in third octaves and 10.0 dB (2.0 dB per frequency band – 5 bands) in octaves. An unfavourable deviation at a particular frequency occurs when the result of measurements is less than the reference value. Only the unfavourable deviations are taken into account. After the progressive curve shifting, $L'_{n,w}$ (dB) is the value of the reference curve at 500 Hz.	Per frequency band : $L'_{nT} = L_i - 10 \lg (T / T_0)$ (dB) L_i :Received impact noise (raw impact noise level) T : RT reception room T0 : Reference RT value If background noise spectrum as an input, there is an additional correction. (cf (3))	Computation is carried out taking into account the frequency bands ranging from 100 to 3150 Hz in third octaves and 125 - 2000 Hz in octaves. The reference curve (cf table 4) is shifted in steps of 1 dB towards the measured curve (L'nT spectrum) until the sum of the unfavourable deviations is as large as possible but no more than 32.0 dB (2.0 dB per frequency band – 16 bands) in third octaves and 10.0 dB (2.0 dB per frequency band – 5 bands) in octaves. An unfavourable deviation at a particular frequency occurs when the result of measurements is greater than the reference value. Only the unfavourable deviations are taken into account. After the progressive curve shifting, $L'_{nT,w}$ (dB) is the value of the reference curve at 500 Hz.
Result	Single number value in dB $L'_{n,w}$	Result per octave or third octave bands, over the whole frequency of the input spectra quantities L'_{nT}	Single number value in dB $L'_{nT,w}$

21.4.3.Mechanical equipment noise

French standard	Normalised equipment noise level LeT
Standard	NF S 31-057
Inputs	- 1 equipment noise level in dBA (received noise level when the equipment is working) - 1 RT spectrum
Parameters	Reference RT value
Frequencies	- Octaves or third octaves - Le input RT spectrum must contain at least the frequency bands 250Hz and 500 Hz
Computation	$L_{eT} = L_e - 10 \lg (T / T_0)$ (dBA) L_e : Raw equipment noise level T : RT reception room T_0 : Reference RT value T is defined as the arithmetic average of the measured reverberation time in the frequency bands 250 and 500 Hz.
Result	Single number value in dBA L_{eT}

21.4.4.Absorption coefficient

ISO standard	**Absorption coefficient αs**	**Weighted sound absorption index αw**
Standard	ISO 354 (NF EN 20354)	ISO 11654 (NF EN 11654)
Inputs	2 RT spectrum : - TR_1 : RT empty room - TR_2 : RT room with test specimen	- 1 Absorption coefficient spectrum α_S
Parameters	- V : Volume of empty reverberant room (m^3) - S : Surface of test specimen (m^2)	
Frequencies	- Third octaves	- Third octaves - The α_S spectrum must contain the frequency bands ranging from 100 to 5000 Hz
Computation	Equivalent absorption area of test specimen per frequency band : $A = 0.16 * V * (1/T_2 - 1/T_1)$ (m^2) - TR_1 : RT empty room - TR_2 : RT room with test specimen $\alpha_S = A / S$ no unit	**1- Calculation of practical absorption indice per frequency band:** $\alpha_{pi} = (\alpha_{i1} + \alpha_{i2} + \alpha_{i3}) / 3$ no unit i : octave band i α_{i1}, α_{i2}, α_{i3} : sound absorption indices (α_s) for the three third octave bands of the octave band i. The averaged value is computed to the second decimal and rounded by steps of 0.05, with a limitation of α_{pi} = 1.00 for the rounded averaged values greater than 1.00. Examples of rounded values : 0.92 is rounded to 0.90, 0.93 is rounded to 0.95 0.97 is rounded to 0.95 0.98 is rounded to 0.90+0.1. **2- Computation of the weighted sound absorption index α_w :** A translation of the reference curve is performed (Cf table 6) by steps of 0.05 towards the measured values until the sum of the unfavourable deviations is less than or equal to 0.10. An unfavourable deviation at a particular frequency occurs when the result of measurements is greater than the reference value. Only the unfavourable deviations are taken into account. α_w is the value of the shifted reference curve at 500 Hz.. **3- Add shape indicators :** Each time a sound absorption index α_{pi} exceeds the value of the reference by 0.25 or more, one or several shape indicators are added, between brackets, to the α_w value. If the absorption excess occurs at 250 Hz, use the notation L. If the absorption excess occurs at 500 or 1000 Hz, use the notation M. If the absorption excess occurs at 2000 or 4000 Hz, use the notation H.
Limitations	The equivalent absorption area A_1 of the empty room measured per octave bands must be greater than values given in table 5, when multiplied by a factor $(V/200)^{2/3}$ $A_1 = 0.16 * (V / T_1)$ (m^2) The curve of the equivalent sound absorption area of the empty room as a function of frequency must be regular and should not present any holes nor peaks of amplitude greater than 15% of the averaged value of the two adjacent third octave bands.	
Result	Result per third octave bands, over the whole frequency of the input spectra quantities α_s in option : A_1 A	Single number value + shape indicators, if required α_w: for example 0.70 (MH) in option : α_p Result per octave bands ranging from 125 to 4000 Hz

❑ Background noise correction

(1) : Background noise correction for NF S 31-057 French Standard
When the level difference between the noise source level and the background noise level lies in the range 5 to 7 dB (limits included), 1 dB has to be subtracted to the measured values.
If the level difference is less than 5 dB, the measurement is considered as not significant. However, if the quality requirements of the measurement have been fulfilled, the result may be obtained

(2) : Background noise correction for ISO 140-3 and ISO 140-6 standards
If the level difference is less than 15 dB but greater than 6 dB, the background noise correction factor is given by the formula :

$$\mathbf{L} = 10 \lg (10^{Lsb / 10} - 10^{Lb / 10})$$

L : Corrected noise level (dB)
Lsb : Combined signal and background noise level
Lb : Background noise level

If the level difference is less than 6 dB, for any frequency band, the background noise correction is equal to 1,3 dB. This correction correspond to a level difference of 6 dB.

(3) : Background noise correction for ISO 140-4 and ISO 140-7 standards
If the level difference is less than 10 dB but greater than 6 dB, the background noise correction factor is given by the formula :

$$\mathbf{L} = 10 \lg (10^{Lsb / 10} - 10^{Lb / 10})$$

L : Corrected noise level (dB)
Lsb : Combined signal and background noise level
Lb : Background noise level

If the level difference is less than 6 dB, for any frequency band, the background noise correction is equal to 1,3 dB. This correction correspond to a level difference of 6 dB.

❑ Tables of values used for the standard calculations

Table 1 –Sj reference spectrum values for road traffic noise (standard NF 31 057)

Frequency	Sj values per third octave band (dB)	Sj values per octave band (dB)
100	66	71
125	66	
160	66	
200	65	70
250	65	
315	63	
400	62	66
500	61	
630	61	
800	61	65
1000	60	
1250	59	
1600	59	63
2000	58	
2500	56	
3150	54	57
4000	52	
5000	50	

🕮 ***Note : For pink noise reference spectrum, this value is constant whatever the frequency band.***

Table 2 –Cj values for A-weighting for computation of single number values in dB(A) (standard NF 31 057)

Frequency	Cj values per third octave band (dB)	Cj values per octave band (dB)
100	-19,1	-16
125	-16,1	
160	-13,4	
200	-10,9	-8,5
250	-8,6	
315	-6,6	
400	-4,8	-3
500	-3,2	
630	-1,9	
800	-0,8	0
1000	0	
1250	0,6	
1600	1	1
2000	1,2	
2500	1,3	
3150	1,2	1
4000	1	
5000	0,5	

Table 3 – Reference values for airborne noise (ISO standard)

Frequency	Reference value per third octaves (dB)	Reference value per octaves (dB)
100	33	36
125	36	
160	39	
200	42	45
250	45	
315	48	
400	51	52
500	52	
630	53	
800	54	55
1000	55	
1250	56	
1600	56	56
2000	56	
2500	56	
3150	56	

Table 4 – Reference values for impact sound (ISO standard)

Frequency	Reference value per third octaves (dB)	Reference value per octaves (dB)
100	62	67
125	62	
160	62	
200	62	67
250	62	
315	62	
400	61	65
500	60	
630	59	
800	58	62
1000	57	
1250	54	
1600	51	49
2000	48	
2500	45	
3150	42	

Tableau 5 – Maximal values of sound absorption for a room of volume V = 200 m^3 (ISO standard)

Frequency	125	250	500	1000	2000	4000
Equivalent sound absorption area, m^2	6.5	6.5	6.5	7.0	9.5	13.0

Table 6 – Reference curve values for computing the weighted absorption index α_w (ISO standard)

Frequency	250	500	1000	2000	4000
Value	0.80	1.00	1.00	1.00	0.90

21.5. Room criteria

dBBATI32 allows the user to compute the following room criteria :

- **Quality criteria :** RT, EDT, Clarity, Definition, ST1.
- **Intelligibility criteria :** STI, RASTI.

This chapter present the definition of each index and a brief introduction to their meanings.

These criteria are obtained from echogram curves per frequency bands. These curves result from an analysis by digital filtering from an impulse response of the room. This response may be obtained by MLS technique.
For each criterion, the computation principle is identical. It may describe as follow:

For each frequency band (octaves or third octaves) :

- Detection of the arrival of the direct wave and computation of the background noise level before the source signal is emitted.
- Detection of the end of signal emission and computation of the background noise level after source emission.
- Calculation of the cumulated energy between the start and a given point of the echogram, with or without background noise removal.
- Calculation of the criterion with or without background noise removal, by cumulating difference.

📖 *Refer to **chapters 11 and 18** to know how to compute room criteria*

21.5.1.Reverberation time

❑ RT 60

The reverberation time, for a given frequency and a given location in space, is defined as the time taken for a sound to decay by 60 dB after the sound source is abruptly switched off. The decay must be more or less constant.
The reverberation time is usually estimated between –5 to –35 dB of sound decay.

Subjective evaluation
The RT60 is an indicator of the reverberant feel, or sonorousness, of a sound field. If the reverberation time is too short, the acoustic field of a room may be considered as too « dry ». If the reverberation time is too long, the acoustic field of a room may be considered as too « confuse ».
For speech : The RT value must not be too long in order to avoid a masking effect (RT 60 < 1 to 1,3 s).
For music : The RT value must not be long, otherwise the sounds may not be distinguished from one another. The obtained result is a confuse.
The influence of RT 60 may not evaluated on its own as it always combine the level of the reverberant part of the echogram with respect to the direct sound.

❑ EDT (Early Decay Time)

The Early Decay Time could be considered as a short reverberation time computed on the first 10 dB of the sound decay. The EDT is measured between 0 and -10 dB and extrapolated to a 60dB sound decay.

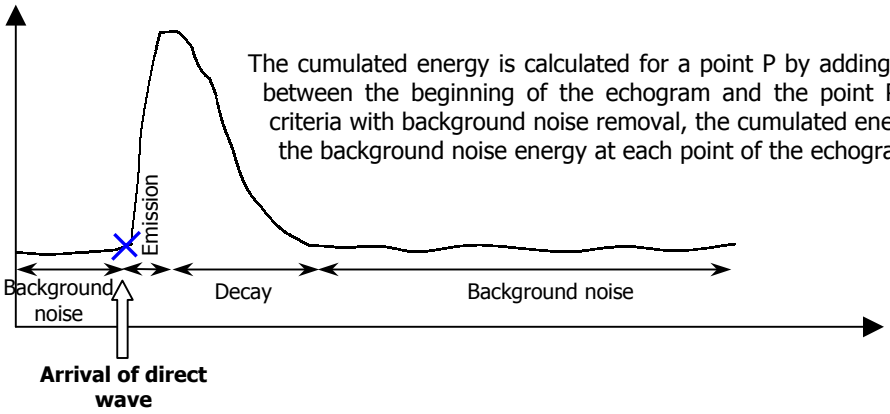
The idea to limit the RT measurement dynamic to 10 dB comes from the fact that, during a concert, the human ear can only rarely listen to sound decay of greater dynamic.

The EDT value is compared to the RT 60 value. It allows us to estimate the balance between the early sound energy and the overall sound energy. The more the energy is concentrated at the beginning of the response (sound not useful), the greater the sound decay slope, and the shorter the EDT. The EDT is useful because it takes into account the effect of the first sound reflections in a room, and therefore it is closer to the subjective judgement of the listeners.

Subjective evaluation
This criterion appears to be closely related to the reverberation feel of the room, although it interpretation remains difficult. The EDT is linked to several others sensations such as the sharpness of attacks and their intensity.
For the same room (same volume), there is a significant difference between the RT60 and EDT values. The EDT varies more quickly as a function of distance than the RT.

21.5.2.Energy criteria

❑ **Calculation of cumulated energy and energy criteria**



The cumulated energy is calculated for a point P by adding the energy of each point located between the beginning of the echogram and the point P. If one wishes to calculate the criteria with background noise removal, the cumulated energy is calculated while subtracting the background noise energy at each point of the echogram.

Each integral used to compute the criteria correspond to the difference between two cumulated energies. For example, the Clarity 80 will give :

$$\int_0^{80ms} h^2(t).dt = cumul(80ms) - cumul(ondedirecte)$$

There is a relationship between the sound energy contained in a given time interval and the sound energy in the following time interval. Several time intervals have been proposed : 33, 35, 50, 80 and 95 ms. For each interval, the main idea is the same : the energy contained in this interval is considered as useful and the energy of the next time interval is considered as secondary or even harmful in particular cases.

This comes from the functioning of the ear. The ear cannot differentiate sound reflections that occur in less than 35, 50 or 80 ms. The individual contributions of the first reflections are therefore added. These energy relationships describe the subjective indicators such as Clarity.

❑ **Clarity 80**

This criterion, defined by Reichardt, is the ratio between the sound energy contained in the first 80 milliseconds of the impulse response after the arrival of the direct wave (where the time T is set to zero) and the energy contained in the rest of the impulse response. It draws a relationship between the subjective sensation of a sound field and the interpretation of reflected sounds by the ear :

$$C80 = 10.\log\frac{\int_0^{80ms} h^2(t).dt}{\int_{80ms}^{\infty} h^2(t).dt} = 10.\log\left(\frac{E80}{Erev}\right) \qquad \text{(in dB)}$$

with h(t) the impulse response of a room.

This parameter is negative when the energy after 80ms is greater than the energy in the range 0-80ms. It is positive when the energy after 80ms is less than the energy in the range 0-80ms (E80 > Erev).

Subjective evaluation

This criterion is mainly employed for music. It translates subjective sensations dealing with :

- The definition
- The discrimination
- The sharpness of attacks
- The differentiation between different voices
- The transparency
- The source location, etc.

Values
The measurement of the clarity coefficient C80 is performed with an Omni-directional microphone.

Examples of values for known auditory (1) :

Auditorium	Smallest value	Averaged value	Greatest value
Gross Musikhereinsalle (Vienna)	-5,30	-2,90	-0,30
Salle Pleyel (Paris)	-3,37	-0,70	4,37
Auditorium M. Ravel (Lyon)	-3,07	-0,13	2,88

(1) JULLIEN J.P.
Acoustique des Salles, CNET LANNION, 1982, p.19

In general, values around 0 dB mean that the acoustics of a room is well suited for listening to symphonic music. For music, the limits that are usually used range form -2 to +2 dB. For operas, C80 must lie in the range 1 to 4 dB.

❑ Clarity 50

This criterion, as for C80, is calculated as the ratio between the sound energy contained in the first 50 milliseconds of the impulse response after the arrival of the direct wave (where the time T is set to zero) and the energy contained in the rest of the impulse response. The 50ms threshold is mainly used for speech and very little for music.

❑ Definition

We use the criterion "Definition" (D) of index 50 which is in fact the ratio E50 / Etot :

$$D50 = \frac{\int_0^{50ms} h^2(t).dt}{\int_0^{\infty} h^2(t).dt} = \frac{E50}{Etot}$$ Expressed in en %.

❑ ST1

We use again an energy ratio.

$$ST1 = 10.\log \frac{\int_{10}^{100ms} h^2(t).dt}{\int_0^{10ms} h^2(t).dt}$$ (in dB)

21.5.3.Intelligibility criteria

An intelligibility criteria is essential to characterise the acoustic field of a conference room, a theatre and in more general terms, any place where speech is important. When a speech signal is produced in a room, normally or with the aid of a speech amplification system, the syllables tends to mask each other because of the multiple reflections and the reverberant sound spoken word so that the listener may not clearly distinguish them. When the speech sound level is too weak with respect to the background noise, the intelligibility is too low because of this masking effect.

Various objective criteria are available to qualify the speech intelligibility of a room. The C50 Clarity coefficient OR the D50 definition (see preceding paragraph) can be used to estimate speech intelligibility although they do not take into account the background noise level.

❑ STI (Speech Transmission Index)

The STI index is an objective criterion that characterise speech intelligibility. The STI is an indicator that takes into account all the possible causes of speech intelligibility alterations, excepted the non-linear effect.

STI formula

Let first recall that any alteration of the signal modulation may be expressed at a signal to noise ratio. We start with the acquisition of a M.T.F.(Modulation Transfer Function) for the octave bands ranging from 125Hz to 8kHz, covering the whole frequency range of speech phones.

Any modification of the room characteristics result into an effective reduction of the signal modulation with a delay. The M.T.F may be obtained from the impulse response of the room h(t) by calculation of the modulation index m(F) for low frequencies F, contained in the speech modulation.

$$m(F)=\frac{\int_0^\infty h^2(t).e^{-2j\pi Ft}dt}{\int_0^\infty h^2(t)dt}.\frac{Iparole}{Iparole+Ibruit}$$

The numerator is the squared Fourier transform of the impulse response. Ispeech and Inoise are the respective sound intensities of speech and noise.

Let compute signal to noise ratio per frequency bands such as:

$$S/N_k(F)=10\log\frac{m(F)}{1-m(F)}$$

We then calculate the mean $\overline{S/N_k}$ after limitations of the *S/Nk(F)* to ±15 dB.

$$\overline{S/N_k}=\frac{1}{n}.\sum_F S/Nk(F)$$

n being the modulation frequency number.

Let now calculate Transmission indices for speech per frequency band :

$$\overline{TI_k}=\frac{\overline{S/N_k}+15}{30}$$

The STI is the weighted sum of the TIk :

$$STI=\frac{\sum_F(W_k.TI_k)}{\sum_k Wk}$$

Use of the STI index

The STI allows us to measure the critical distance dc for which speech intelligibility becomes bad. Indeed, it decays relatively quickly at short distances of the orator, then from the distance "dc", it becomes more or less constant, reflected sounds being predominant.

For conference rooms with absorption coefficients varying from 0,1 to 0,4, the distance dc is between 15 to 20 meters.

❑ RASTI (RApid Speech Transmission Index)

The RASTI method allows us to perform objective measurements of the qualities of speech intelligibility. The computation technique is similar to the STI calculation, with the following differences :

- The octave bands 500 Hz and 2 kHz are not taken into account
- All signal to noise ratios (Xi) are limited to ±15 dB
- The arithmetical average $(\overline{Xi})$ for all Xi are performed

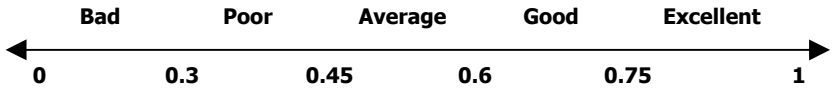
$$\textbf{RASTI} = (\overline{Xi} + 15) / 30$$

There are additional limitations to the validity of RASTI measurements :

- Distortion and non-linear cut-offs are not considered.
- The emerging pure tones of the background noise outside the frequency range 500 Hz – 2 kHz are not allowed. It is assumed that the background noise is stationary during the whole measurement.

Values

The STI and RASTI criteria vary between 0 and 1. There is a scale to interpret the intelligibility from the se values:



🕮 *References*

This annex uses extracts from :

- *The study report from C.LUQUET and J.BEAUMONT established for Laboratoire Régional des Ponts et Chaussées of Strasbourg (France) on room acoustics. It itself refer to the work of J.P. VIAN and R. CROCOMBETTE (Master in acoustics) carried out at the CSTB (Centre Scientifique et Technique du Bâtiment de Grenoble) and the work of J.P. JULLIEN and A.C. SEVERNE from IRCAM in Paris.*

- *The thesis realised by V. FAVRE pour l'Ecole Supérieure de Mécanique de Marseille (1998)*